PUBLIC WORKS

Devoted to the interests of the engineers and technical officials of the cities, counties and states

AUGUST, 1938

A. PRESCOTT FOLWELL, Editor — VOL. 69. NO. 8 — W. A. HARDENBERGH, Asso. Editor

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TIMEWASTERS

"As Mr. Bevan may be anxiously and impatiently awaiting the answer to his question 'How old is Dora?,' I hasten to let him know the lassie's age," writes James A. Vinson, one of our old and esteemed correspondents from Kentucky. And he continues: " 'Four years before I was born'," begins Dora. Putting Dora's age now at x, this is x plus 4 years ago. At that time, Dumb was $28-(x+4)$ years of age. We pause here, stick a pin and mark it A."

"Winds up Dora, 'when you were five years younger than I am now.' That is, when Dumb was x-5 years of age, or 28-(x-5) years ago. At that time Dora was $28-[28-(x-5)]=2x33$ years of age. This is the place for the second pin, marked B. Now from the conditions stated, A is twice B, so $28-(x+4)=2(2x33)$, whence Dora is 18."

"And," continues, Mr. Vinson, "let the engineers solve the old swimming hole problem. It would be good exercise for Mr. Bevan, to keep him out of mischief while waiting for the answer to his Dumb and Dora problem; and Mr. Blunk might try his hand at it." Well, Mr. Blunk did try his hand at it, with his usual skill, and finds the water to be 17½ feet deep; and Mr. Blunk also checks on the age problem. Thanks, gentlemen. We do enjoy your letters.

Foolish Problem No. 1:

Sprung on us on the train going home the other evening: Take the word "FIVE." Take away two letters and have four left; then take away one and and have five left.

The Hog-Breeder's Will:

A man, at his death, owned a large drove of hogs (or is it a flock or a bevvy, or what?) His heirs were 5 sons, 4 daughters and a nephew. His will provided that the eldest son should take one-fifth of the drove, and the other sons, by age, one fifth of the successive remainders, with the indivisible portion of the remainder going to the nephew; and the residue to be divided equally among the daughters. Accordingly, the drove was divided into five equal parts, with the resulting one extra, or odd, hog going to the nephew. The eldest son took one-fifth; the other four-fifths were again divided into five parts, there again being one odd hog, and the second son taking one of these fifths, while the other four were again divided into fifths; the process was repeated for the third, fourth and fifth sons, in each case there being an odd or indivisible hog. The remainder of the drove was then divided among the daughters, there being no residue. The nephew got 5 hogs; how many hogs were there in the beginning, how many did each of the sons get, and how many did each of the daughters get?

Thanks and best wishes. *W. A. H.*

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LET'S MEASURE CALCIUM CHLORIDE ROAD IMPROVEMENT BY THE *Results*

IN considering the merits of any highway material, all other factors are overshadowed by this, the most important question—"What will it do, what results can we expect?"

The story of calcium chloride's benefits is too long to be told on a single page but, since all final judgments are based on results, let's look over a few "result" reports from typical users.

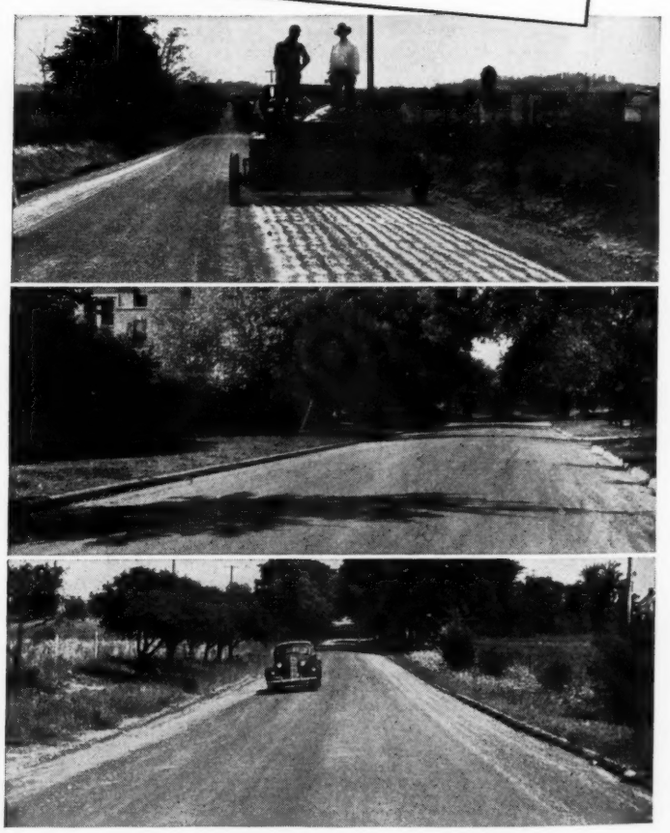
Allan Williams, Engineer of Ionia County, Michigan says: "Experience over a period of many years leads me to say that gravel roads consolidated with binder soil and calcium chloride offer the best possible substitute for paved surfaces. This belief has been frequently confirmed by the motorists who use Ionia County's roads."

John H. Ames, City Manager, Ames, Iowa, says: "The city of Ames was among the first municipalities to make use of soil-stabilized street construction, and our present enthusiasm is based on our very favorable experience with this improvement method. Our first program started in the summer of 1934. During the late summer and fall of 1936 and the spring of 1937, we constructed 3 miles of calcium chloride-stabilized streets, following essentially the same construction procedure. They have set up very firm and hard, and two surface applications of calcium chloride per season have kept them absolutely dustless."

Ray A. Traver, Superintendent of Highways, Onondaga County, New York, says: "The savings effected by stabilization are just as important as the low initial costs. Not a shovelful of new gravel has been added to any of the county's stabilized roads—not even on those 4 and 5 years old—which means an annual saving of at least 300 cubic yards of gravel per mile. The average cost of maintenance on Onondaga County's more than 400 miles of stabilized roads is $302 a mile, including the cost of the calcium chloride. Thus, from the standpoint of maintenance expense alone, stabilized roads more than pay for themselves."

V. E. Best, Superintendent of Public Works, Albion, Penna., says: "We are completely convinced that, in low-cost calcium chloride-stabilization, we have found the answer to our unpaved-streets problem, and we intend to continue stabilizing our streets as rapidly as conditions will permit."

A. L. Burridge, Consulting Engineer for Antrim, Benzie, Grand Traverse, Kalkaska, Manistee, Misaukee, Roscommon and Wexford Counties, Michigan, says: "The smooth, comfortable riding qualities of a gravel road properly consolidated through intelligent use of clay and calcium chloride is unequalled even by rigid type pavements, and, in my opinion, there is no better, practical way for counties with limited funds to make widespread improvement of their gravel road systems."



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PUBLIC WORKS
City, County and State Engineering and Construction

AUGUST, 1938
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Getting Streets and Roads Ready for Winter

Well planned winter maintenance includes two principal phases of work —preparation of the road structure for winter, and the actual organization for and control of snow and ice during the cold winter months. Getting ready for winter means far more than merely putting snow plow attachments on trucks and tractors and wheeling the snow plows out of summer storage.

THE work of preparing the road structure for winter includes surface maintenance and patching, opening drains and ditches, filling cracks and joints, repairing shoulders, and cutting brush. Attention to these details will not only make the road safer for cold weather use, but will help to minimize, or may even prevent, damage from excessive moisture, low temperatures and alternate freezing and thawing.

Organization against snow and ice requires provision for an adequate labor force, equipment for snow removal, sand or cinder piles and their application during icy periods, placing snow fence and many other details.

Getting the Roads Ready for Winter

Drainage.—Proper drainage is perhaps the most important single item in carrying road and street surfaces through the winter. It involves at least three varieties of work: correcting depressions in the surface which will hold water; providing good surface drainage; and taking care of subsurface drainage. The first mentioned will be discussed in connection with patching and resurfacing.

Surface Drainage.—Side ditches, catch basins, drains and culverts should be examined in the late fall and cleaned if necessary. A partly clogged culvert or ditch is especially likely to cause trouble during a freeze following a thaw.

Because such places may show but little evidence of trouble even shortly after a rain, inspections should be made during or immediately after a heavy rain. Using a closed car such work is not too difficult even in very bad weather. Each spot showing a threat of trouble should be marked with a numbered stake or other indicator and full notes made at once regarding the defect and the suggested treatment.

The defect may consist of a blocked ditch or culvert, which backs up the water so that it covers a portion of the road, or flows over the road. The remedy for this is usually to open and clean the ditch or culvert. Or the difficulty may be caused by the road shoulders being higher than the surface of the highway, in which case a pool will form along the edge of the road. The treatment in this case is to grade down the shoulders; or, if this can not be done at once, to cut ditches across the shoulder at intervals. Inspections to locate defects of this type should be made during a storm or within a few minutes after it has ceased.

On hills, due to high shoulders or imperfect ditches, water may be diverted from the higher side of the road to the lower side, flowing in a thin stream across the surface. Such conditions are very conducive to slippery places in the winter, with accompanying accidents. The conditions found will usually indicate the treatment to be received. Time of inspections to locate such points

Potholes are cleaned out carefully, sprayed or painted, and filled with stone, which is then sprayed.

The final step in patching is to apply the seal coat and broom the last chips smooth.

will depend on local conditions, and may be during a rain, or immediately following one when there is still considerable surface runoff.

On some two- and three-lane concrete surfaces, water may ooze up through the longitudinal joint and flow across, or down the center of, the highway for some distance before turning off into the ditch. These areas create especially dangerous conditions in cold weather, since they usually occur on a hill. Trenching along the sides of the road, and the installation of a perforated or other drain pipe to cut off the underground flow of water, will usually remedy this condition. Inspections to determine this condition should be made when the soil is very wet, as even heavy showers, if short, may not soak the ground sufficiently to make it apparent.

Subsurface Drainage.—The two principal subdrainage problems are interception drainage to prevent water from entering the subgrade or to bleed it out; and drainage to control the capillary water from rising. In either case subsurface drains are used.

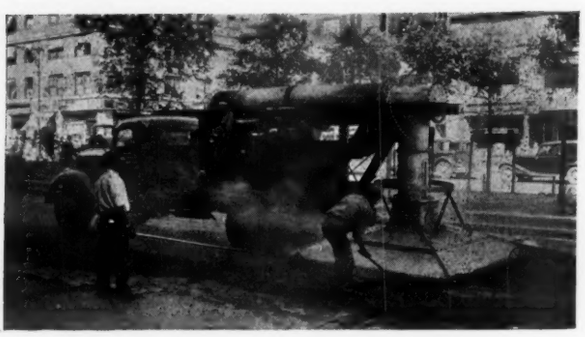
Interception drainage is designed to cut the flow from a water bearing stratum before the water flows under the road. Such work is needed in cuts and on sidehill construction. A subdrain in the gutter of the side from which the flow comes, will intercept it. This should be sealed on top to prevent surface water from entering.

Frost heave and frost boils are manifestations of capillary water in certain types of soils, or of high water table. A single subdrain down the center of the road, or one under each shoulder will lower the water table, and will reduce the amount of capillary water or lower it sufficiently to permit a more stable subgrade.

Details of subgrade drainage are covered in a 32-page booklet available from the editor on request. Ask for H-36.

Repairing the Surface

Patching.—A hole that retains water may offer a dangerously slippery spot in the winter, but its repair is even more important from the viewpoint of preserving the highway surface. A neglected small hole in the fall may be a large hole in the spring. Clean the hole thoroughly, removing all doubtful material: cut the edges back so as to make them vertical. In repairing, use the same material as was used originally, as tar or asphalt; paint the edges with tar or asphalt cutback and fill with cold patch material, or fill with good quality stone (the size depending on the depth and dimensions of the hole) and spray with hot material. Consolidate the patches thoroughly—a roller gives best results. If a seal coat is to be applied later, a slight underfill is better than a bump, since the seal coat will bring it up to grade.



A surface heater helps in fall maintenance.

Patches that have been made during the summer should be inspected in the fall, and if they show an open surface they should be sealed before going into the winter. Many patching mixtures are not well graded and disintegrate if they are not sealed to prevent water entering and freezing within them. For this use a cut-back tar or asphalt, a cold refined surface treatment tar or a medium or rapid curing asphalt. A light cover of coarse sand, fine gravel, or slag, or small sized stone chips will be needed. Even patches on roads which are to be surface treated should be sealed ahead of the treatment if they are at all open. This prevents the tar or asphalt in the surface treatment from going down into the patch. Sealed patches will be concealed by the surface treatment.

Cutting weeds and brush helps snow drift prevention and improves appearance.

Resurfacing.—A light surface treatment on a road that has been properly patched and prepared is good preparation for winter as it smooths up and waterproofs the surface. Such work can be carried on as late as October in the north and late November in the south. It is best to keep the work well in hand, so as to reduce to a minimum the section uncompleted if bad weather intervenes.

Seal Coats—With many types of surfaces, the application of the seal coat is delayed until the surface has cured. Seal coats may often be delayed until fall but should usually be applied then in order properly to carry the pavement into the winter. In a similar manner the seal coat is often omitted on gravel mulch treatments done during the summer. If the surface is at all open when the road is inspected in October, a light seal coat should be applied. This may run from ⅛ to ¼ gallon per square yard. Generally the same grade of bituminous material as was used in the mixing should be used for the seal coat.

All treated and pavement surfaces should be inspected in the fall to see that they are well sealed before being subjected to winter conditions. A late fall seal coat has saved many a road that would have been seriously damaged before the next summer. Both cold and hot surface treatment materials are used for this purpose. It may be sufficient in some cases to seal only a portion of the surface. One street superintendent, whose residence streets are practically all tar-treated gravel, spends about a week each October with a tar truck and

a hose, spot sealing the places he considers weak. As a result he never has any serious breaks in the spring.

Filling Joints and Cracks.—The fall is an excellent time to fill the cracks and joints in concrete roads and streets. The concrete has contracted and the cracks are more open than in the summer and there is the additional advantage of sealing these openings just before winter sets in. A tar having a float test at 50° C of 100 to 160 seconds can be used for this purpose, heated to about 250° F and poured into the cracks and joints. A sand is generally used to prevent picking up by traffic. Hot asphalt cements, with or without mineral filler, cutbacks, and emulsified asphalts are also used.

For filling wide cracks and joints, a plastic tar mixture applied cold has been used for several years. This plastic tar is shipped in metal drums. A plate carrying a pump and a hose fits into the top of the drum and is held in place by clamps. A hand crank furnishes the power to force the tar, under pressure, through a hose and nozzle into the crack or joint. A sand and asphalt mixture (sand and 2% to 3% by weight of cutback asphalt) brooms into cracks readily and can be sealed with a small amount of cutback asphalt.

Before filling them, cracks and joints should be cleaned well, preferably by an air jet, and all loose particles removed. The crack should be reasonably dry and the filler hot enough to reach the bottom of the opening before it cools.

Smoothing Up Pavement Slabs.—Slabs that have settled materially out of place may let water through into the subgrade, may retain water and permit it to freeze, and also may offer a hazard to snow plows. To a lesser extent the same apply to sidewalk slabs, and these also are dangerous to pedestians when an icy spot forms.

The surfaces can be leveled up by patching with tar or asphalt mixes; or by the use of the mudjack the slabs can be brought up to the level of the adjacent slabs. When the slabs are not broken this is usually the most economical way.

Other Work to be Done

Shoulder Maintenance.—The shoulders of all surfaced roads should be inspected and repaired in the late fall. If the shoulders are higher than the traveled way they should be graded off so that the water can get to the side ditches. On the other hand, the shoulders are often low at the edge of hard surface pavements. These low spots should be filled so that they will not hold water and also to prevent a dangerous rut at the edge of the pavement. Shoulders of gravel or stone may be waterproofed by bituminous treatment followed by a light sand or stone cover. Work of this kind can be done in October and, under favorable conditions, in November. Such a treatment will prevent surface water from going down under the edge of the pavement and also will strengthen the shoulder.

Don't forget to clean out ditches and take care of both surface and subsurface drainage.

Cutting Brush.—Drifts are caused when the wind velocity is so reduced that the snow is deposited. Brush on the side of the road from which the prevailing winds blow should be removed. On the other hand, brush 100 feet or more from the road may act as a snow fence. Most every maintenance foreman knows where drifts form and should be able to judge the effect of brush.

Left, patching dense road-mix; right, concrete mixer for cold patch material.

Building Princeton's Storm Water System

By I. RUSSELL RIKER
Engineer for Princeton Borough

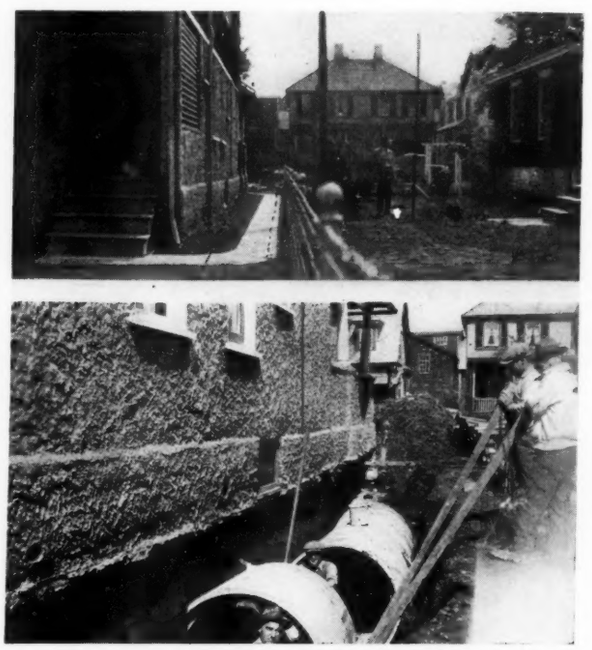
PRINCETON, N. J., in 1932 completed 13 miles of sanitary trunk sewers and a new treatment plant, thus pretty well solving its sanitary sewerage problem. But until recently no general system of storm drainage had ever been designed, and only a few drains constructed, most of them on state and county highways and by private individuals. With the availability of relief labor through ERA in 1933 it seemed desirable to make a systematic beginning at providing drainage of parts of the borough where its need had long been felt.

Princeton occupies the summit of a hill and its slopes in all directions, that to the north being very gentle, with an intervening valley in which Harry's Brook begins and runs through the borough for three quarters of its length, emptying into Carnegie Lake, which lake also receives other small streams that drain the borough. A study of the topography led to division of the municipality into 17 drainage districts, each with a single separate outlet. The probable run-off of each district was calculated, using the rational method, with R about 2" per hour (the maximum average rate of rainfall over the area).

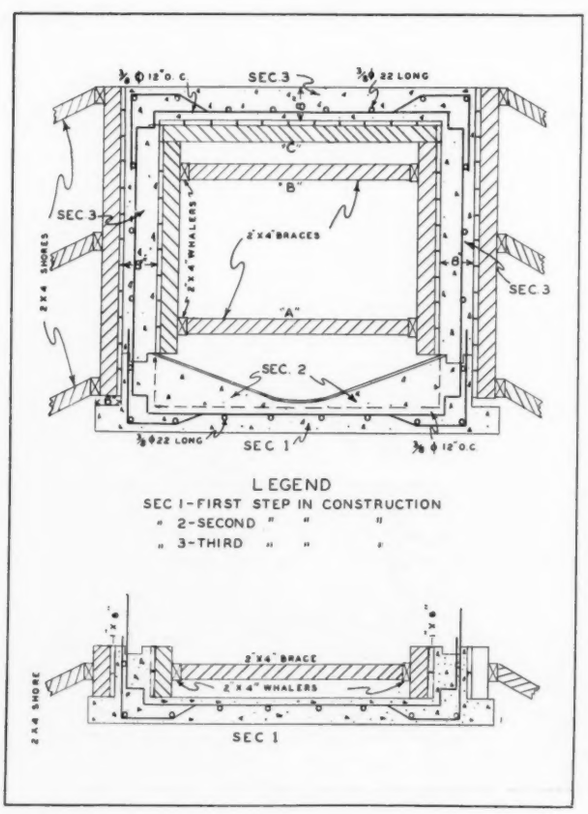
The main drainage district was that of Harry's Brook, which contained a total of 156 acres. This brook had been covered by private individuals in a number of places without proper provision for the future flow, or in some cases for that of the present. Several times each year the area in the vicinity of Madison St. was flooded; it was quite common to have materials stored in cellars float out the cellar windows. The municipality disclaimed any responsibility for this condition, although citizens claimed that increased building in the business section and impervious street pavements contributed to increase the flow. Investigations were made by the Mercer County Engineer's office, which has a certain responsibility covering the stream, and by the State Water Policy Commission. It was claimed that Princeton University was partly responsible because roof water from its buildings had been diverted to this brook. With this divided responsibility, contributions to the cost of the drainage work done during the past four years have been made by county and state as well as borough; while Federal contributions of labor through CWA, ERA and WPA accounted for nearly 70% of the total.

The work done in the Harry's Brook district during the four years and contributions to the cost are summarized on the opposite page table:

The $9,000 contributed by the borough includes value of surveys, engineering, supervision and truck service supplied by our regular staff; also the estimated value of materials in stock or reclaimed from other bor-



Top—Location of storm drain. Bottom—Constructing drain under house wall.



Procedure in constructing Princeton box culvert sewer.

Year Constructed	*Gov. Agency*	*Length*	*Size*	*Total Cost*	*Contributions* *Federal*	*State*	*County*	*Borough*
1933	E.R.A.	460′	Conc. Box Flume 4′x5′	$6,900	$3,000	$2,000	Stone $1,600 includes culvert	$300
1934	C.W.A.	720′	21″ 24″	$7,437	$6,936		$100	$400
1934	C.W.A.	460′	42″ 48″ 60″	$9,626	$6,526	$2,000	Stone $100	$1,000
1935	C.W.A.	690′	54″	$19,482	$13,695	$2,000		$1,715
	C.W.A.	1,280′	12″ 24″ 27″				Pipe $2,072	
1936	W.P.A.	860′	Rein. Conc. Flume 4′6″x5′6″	$21,961	$15,071	$2,000	Stone $1,250	$3,640
1937	W.P.A.	750′	5′6″x5′6″	$16,925	$11,872	$2,000	Stone $1,100	$1,953
Total		5,220′		$82,330	$57,100	$10,000	$6,222	$9,008

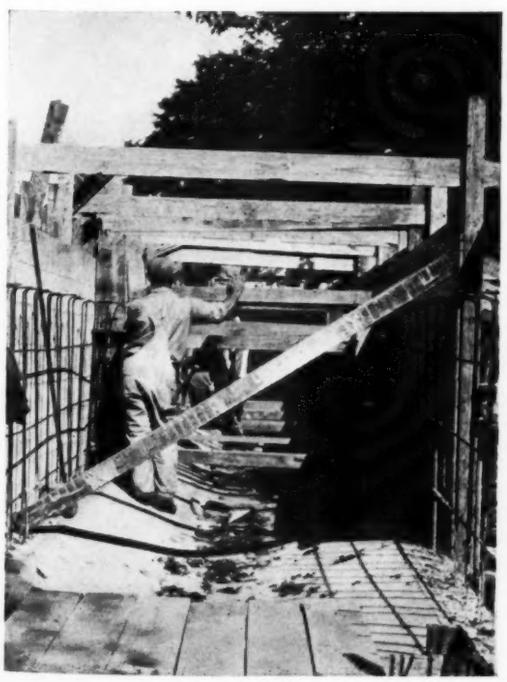
ough work. In addition the county assumed the entire cost of a new culvert. In 1933, when relief labor became available through ERA, 460 ft. of the brook that had been covered by private individuals in a haphazard and inefficient manner was overhauled and replaced by a box culvert about 4 x 5 ft. The old sections had been of various areas; in one place a 5 x 6 ft. section emptied into a 3 x 4 ft. The smaller drain was enlarged by moving one side out, a rounded bottom placed in it to increase velocity during low water, and a new top placed over it.

In 1934 and 1935 the CWA took over the work, and in 1936 and 1937 the WPA contributed to the work. Over a mile of the brook was covered or reconstructed, beginning with a 21″ pipe and completed with a 5′ 6″ x 5′ 6″ section.

This work probably would not have been done, or at least not for many years, if it were not for outside aid. It did not cost adjacent property owners anything, not even an assessment; but they were subjected to some inconvenience due to the fact that the line had to be run through rear yards and in one case under the full length of one side of a dwelling.

At first pipes were used up to 60″ diameter, but as the cost of pipe increased with increasing size, a box culvert was used of a new design similar to that shown in the illustration. As a contract job it probably would have been more economical to construct the entire drain of pipe; but with all labor furnished by the Government and most of the material by the municipality this plan was more economical. (Stone for the concrete was furnished gratis by the Mercer County Workhouse quarry.) The first 800 ft. of box culvert cost approximately $30 a foot, whereas if pipe had been used it would have cost approximately $22; but the pipe would have cost $11 a foot, whereas the cost of materials was only $7, and a good portion of this was contributed in materials and equipment.

After having constructed the first 800 feet the men did much better work on the second 750 feet of the box culvert. The forms were set up as shown in the drawing, and were moved along with the job without breaking them down. They lasted for nearly the entire job and were about used up after the last pour. In stripping the inside forms, cross pieces A and B were first removed and then the walers. Cross piece C at the top was then lowered with top form and moved ahead with side forms to the next section. This eliminated the necessity of rebuilding the inside form, as was the case in the first 800 feet. The total cost was $16,740.15, divided as follows:



Box flume; bottom completed; side forms and steel being set.

Reconstruction of what was a right-angle turn. Sides and bottom to be cemented, top a concrete slab.

Common labor	$1,996.00
Construction labor	5,209.15
Carpenters	2,550.00
Supervision	1,342.00
Materials	5,268.00
Equipment rentals	375.00

The equipment used, a one-bag seven cubic foot concrete mixer, was part of our equipment. The total quantity of concrete used was 503 cubic yards and of steel 22,455 pounds or 44.6 pounds per cubic yard and 30 pounds per foot of length. The cost per foot was only $22.19; the concrete cost $17.90 per cubic yard, $11.75 for labor and $6.15 for materials.

The work program was divided as follows: 1. Divert the brook. 2. Make channel excavation. 3. Set forms and pour footings, leaving key for side walls. 4. Pour inverted bottom, using dry concrete and one-inch top finish. 5. Set outside forms for side walls. 6. Place reinforcement which has already been fabricated. 7. Set inside form. 8. Pour concrete. 9. Strip forms. 10. Finish rough places.

The concreting gang consists of one machine operator, two shoveling stone, one shoveling sand, and five wheeling concrete. Six carpenters, staggered three at a time, were used on forming. Forms were made in eight-foot lengths. The best day's concrete pour was 60 feet top and sides, using 120 bags of cement, 27 tons of stone and 15 tons of sand. The 750 feet took four months to complete, or 60 working days.

Nearly three miles of additional storm drains and some 50 catch basins have been added to our drainage system, while there is at present a W.P.A. project calling for two additional miles and 40 catch basins. These basins are being set on the up-grade side of street intersections, so as to eliminate dish gutters. Not only has this program improved traffic conditions, but it is showing a saving in street maintenance. We are not an advocate of controlling speeding by leaving dish gutters at street intersections, although I must admit that after one gets one good bump on a deep dish gutter he slows down to a reasonable speed, perhaps unreasonable for the traffic of today.

One of the problems in the Harry's Brook built-up district was to provide for cellar drains previously connected to the brook. We advised that sump pumps be installed in the real wet cellars, pumping into the top of the drains, inasmuch as the bottoms of the cellars were only slightly above the dry weather flow-lines of the new storm drains. Some adjacent property owners disconnected entirely, while a few insisted on connecting with the drain. In the case of the latter, their cellar drain was carried down stream at least 100 feet before connecting with the main drain. Although we warned that such connections would not work under high flow conditions, they apparently have served satisfactorily, as water has only backed up in the cellars once in the past three years. In view of the fact that the high-water flow-line where the connections were made is several feet above the bottom of the cellars, the only explanation we can offer for this is that it may be that the suction created at such times is so great as to draw the water out of the cellar connection rather than to permit water to seek its own level.

No special problems were presented by the storm sewer work in the parts of the borough other than Harry's Brook, which job was especially fitted for unemployed because it provided work for a large number of skilled as well as unskilled men.

The greatest rain fall on the district since the work was completed was 1.5 inches per hour, which was handled satisfactorily by the new drains. This rainfall was the heaviest downpour in several years and we feel proved to be a good test of the new system, particularly the Harry's Brook district.

William Madden, a graduate civil engineer, was W.P.A. foreman, and later supervisor for the box culvert work on Harry's Brook. Henry W. Kenarney, Assistant to the Borough Engineer, was directly in charge of the work; while the writer gave it general supervision.

W. H. Weir Retires as Secretary and Treasurer of the S. E. Section of A. W. W. A.

W. H. Weir last April, at the New Orleans meeting, resigned as Secretary and Treasurer of the Southeastern Section of the American Water Works Association, after a period of eight years service to his Section. Mr. Weir also served as director of the American Water Works Association from 1935 to 1937.

Mr. Weideman (left), Mr. Weir (right)

The energy and enthusiasm which he put into his job more than doubled the membership of the Southeastern Section in a few years and won for the section the membership cup given for the greatest increase in membership among the various sections of the American Water Works Association and quickly established the section on a firm and progressive basis.

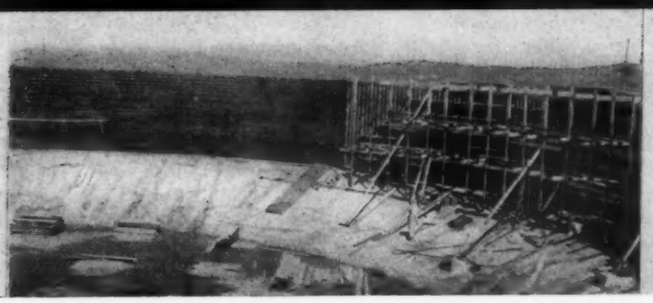
Mr. Weir is also Assistant Sanitary Engineer of the Georgia State Board of Health in direct charge of water supply and sewage work, and has done an outstanding job in promoting better design and operation of water treatment and sewage disposal works, and Works and Sewage Operator's School, which meets once each year. The increased activity of his department made it impossible for him to continue his service with the Southeastern Section and the trustees of the Section reluctantly accepted his resignation offered on this account, and the Section instructed Herman F. Wiedeman, of Wiedeman and Singleton, to present Mr. Weir with a suitably inscribed silver pitcher in recognition of his outstanding service.

The picture herewith shows Mr. Wiedeman (left) presenting Mr. Weir (right) with the silver pitcher on the grounds of the State Capitol at Atlanta, Georgia.

Limitation of Fiscal Year's Indebtedness

The Oklahoma Supreme Court holds, Herd Equipment v. Eagle Township, 68 Pac. (2d.) 420, that whoever contracts with a municipality does so with notice of the limitations on its or its agents' powers. It was therefore held that a township was not liable for the price of road material furnished under a contract entered into during a fiscal year in which funds for payment of the price were not available although the material was not delivered until the following fiscal year. The constitutional prohibition against exceeding the debt limitation is intended to require a municipality to carry on its corporate operations on a cash basis.

Interior view.



Wall forms at right; reinforcement at left.

Collapse of roof forms.

Building Concrete Reservoirs Without Expansion Joints

By PAUL D. COOK

THE waterworks of Sioux City, Iowa, has been a municipally owned utility for the past fifty years. The earnings have paid for the major part of the investment so that the utility has been debt free during a large part of its existence. The late Phil Carlin, water works superintendent, was for nearly fifty years the guiding hand in developing the property and service.

Paul D. Cook

The water supply is obtained from wells from 300 to 600 feet deep which penetrate a sandstone formation interstratified with clay. The contaminated water found in the upper gravel formation is excluded, giving the city a supply of high purity, although harder than desirable.

During 1914 the writer was instrumental in planning a departure from the old high-duty steam pumps with the troublesome vacuum connections to the wells and, by stages, the substitution of electrically driven centrifugal units of about two million gallons per day capacity in sixteen-inch cased wells located where strata proved to be most satisfactory. This well and pump system has gradually displaced the older equipment because of its economy and flexibility, until at the present time the supply is derived exclusively from these units.

From the wells the water is pumped direct to reservoirs to prevent sand getting into the distribution system. The reservoirs are located on the highest hill tops, with gravity distribution giving pressures of 100 to 115 lb. in the business area.

The city has a population of about 85,000. During 1936 there was an average demand of about 8 mgd with a peak of 17 mgd. The maximum demand was evidently increasing more rapidly than previously because of the general installation of air conditioning and low precipitation during the summer months. The pumping capacity was only 17 mgd and reservoir storage capacity 8 mg, and it was decided to increase the latter by 16 mg and the well and pump capacity by two 2 mgd units.

To finance the program, including costs of site, main extensions, etc., an issue of $585,000 water revenue bonds was made and plans and specifications prepared under the direction of the writer as city engineer.

For the new reservoirs a site was obtained about a mile from the existing reservoirs, at an elevation permitting the new reservoirs to be at the same elevation as the old, and in the general direction of the site from which future well supplies must be obtained. Twin reservoirs were built to permit periodic cleaning, repairs, etc., cleaning for sand removal being necessary at 3 to 4-month intervals.

The two new wells, located about two miles from the reservoir, have 16″ well casing, the vertical centrifugal pumps therein being directly connected to a horizontal 2-stage pump operating against a total head of about 350 ft. The wells are located about 500 ft apart to minimize interference in ground water level. Each unit is equipped with rate of flow indicators and integrating and recording meters. The improvements included also about three miles of 30″ monocast pipe, on which were electrically operated Rensselaer valves with remote push button control from the reservoir.

The Reservoirs

Rectangular reservoirs with paved 45° slopes would normally be the cheapest shape, but the topography of the site did not permit this, and instead two circular covered reservoirs were built, about 12 ft. apart, each 220 ft. diameter and water depth from 20 ft. at the circumference to 32.5 at the bottom outlet. For about 28 ft. in from the vertical wall the bottom slopes about 1 vert. to 2 hor., and inside that the bottom is comparatively flat, sloping 6″ toward the outlet, which is at the foot of the slope, and normally connects with the distribution system but can also be used for removing the sand washed out in cleaning the reservoir; which sand, as well as the reservoir overflow, goes to a 24″ storm sewer. This outlet is surrounded by a pipe railing. Two flights of stairs, placed opposite each other in each reservoir, reached by a manhole and ladder and provided with a pipe railing, give easy access to the bottom of the reservoir for cleaning. A 4″ cast-iron pipe is laid around the base of the vertical wall and provided with 2″ hose connections at four points, wash water being furnished by means of a 250 gpm motor-driven pump. Water enters each reservoir through an aerator. Diametrically opposite is an overflow weir 5″ below the underside of the roof.

The reservoirs are of concrete construction throughout. A flat slab roof 7″ thick is supported by 88 columns

21″ diameter, spaced 20 ft. centers, resting on slabs 7 ft. square. The floor is in general 7″ thick, thickened near the side walls to develop bending moment at junction of wall and floor. Floor, wall and roof are all reinforced and tied together, with no expansion joints, and act as a monolith. The walls are 20″ thick at the bottom and 12″ at the top. The roof is covered with 12″ to 18″ of earth.

The aerators, while rather primitive, satisfactorily precipitate a small amount of iron and release H_2S, which in the past has sometimes proved troublesome. Each aerator consists of a 30″x24″x24″ breeches Y, an elbow and short vertical riser from each 24″ branch rising to a few inches below overflow level; while a flat horizontal splash plate 4 ft. in diameter surrounds the vertical pipe about 6 inches below its top. The aerator is covered with a 5x10 ft. louvered pent house sent over an opening in the reservoir roof.

The design was based on use of steel with a working stress of 20,000 lb. and concrete with 2500 lb., the specifications calling for a minimum strength of 3000 lb., with laboratory control. The concrete was mixed dry at the railroad siding and hauled over a mile to the mixer at the site, from which it was distributed in 2-wheel rubber-tired carts. The use of an admix was permitted upon request of the contractor but gave questionable results. Vertical construction joints were permitted at the middle third of floor and roof diameter each way, permitting nine days, with 150 to 200 cu. yds. each, for placing each total slab.

The wall forms were made of ⅝″ plywood in panels 4x20 ft., and the decking for the roof slab employed like material supported on 4″x4″ posts spaced 8x10 ft. As the last section of the roof was being poured, a form failure occurred which dropped about 35 cu. yd. of concrete to the floor, injuring three men. The accident was due to the failure of the nailed connections to the posts, 16-penny wire nails failing under a load averaging about 600 lb. each.

Much of the concrete was placed in summer with temperatures of nearly 100°, while the water temperature is about 55° the year round. This temperature differential produced a slight movement of the floor at the joints, but this was made tight by the contractor by use of "Ironite." After completion, temperature variation in the structures is probably small, as they are insulated on top, as well as sides and bottom, with earth, and the water contents varies only about 2° from normal. The reservoirs have been tested several times by filling with water and closing valves for three or four days, when hook gauge readings at 8 hour intervals showed losses from all causes at first of ¾″ to 1½″ a day, finally lessening to the specified limit of ¼″.

Several test cylinders of the roof slabs, which were poured in cool weather, failed to develop the specified strength; but cylinders cut by a core drill from the part of the roof represented by these test specimens, when tested, developed strength in excess of that required.

The reservoirs were built by the John Kerns Construction Co. at a cost of about $220,000. They were put into service February 14, 1938.

Comparing foresight with hindsight may be helpful to show which ideas have worked out successfully and which one not. We can cite one of each kind on this job, which rested on loess soil. For a small area, the natural ground level was below the subgrade of the floor and was brought up to subgrade level with lean concrete. This caused deformation and local leakage in the floor, which had to be corrected with membrane waterproofing over this area. A more successful idea was that of placing a thin covering of concrete on the subgrade as soon as each section had been brought to final surface; this because loess soil, of which 65% will pass a 200-mesh screen, washes badly with a heavy rain. This thin concrete covering preserved a condition superior for placing reinforcing and concrete.

Asphalt Research Still Necessary

Although scores of investigators and manufacturers have for years been studying the various asphalts, thus far none of these investigations has disclosed the fundamental knowledge necessary to develop a specification guaranteeing satisfactory quality; while improper *use* of materials which would have been satisfactory if their peculiarities had been recognized is responsible for many unsatisfactory bituminous roads. Said T. H. MacDonald, Chief U. S. Bureau of Public Roads:

"When the use of asphalt was essentially confined to asphalt cement, the crude material came from a few known sources with established service records. Although general confidence in the specifications was doubtlessly justified then, no such trust can be placed in these requirements applied to present-day asphalts.

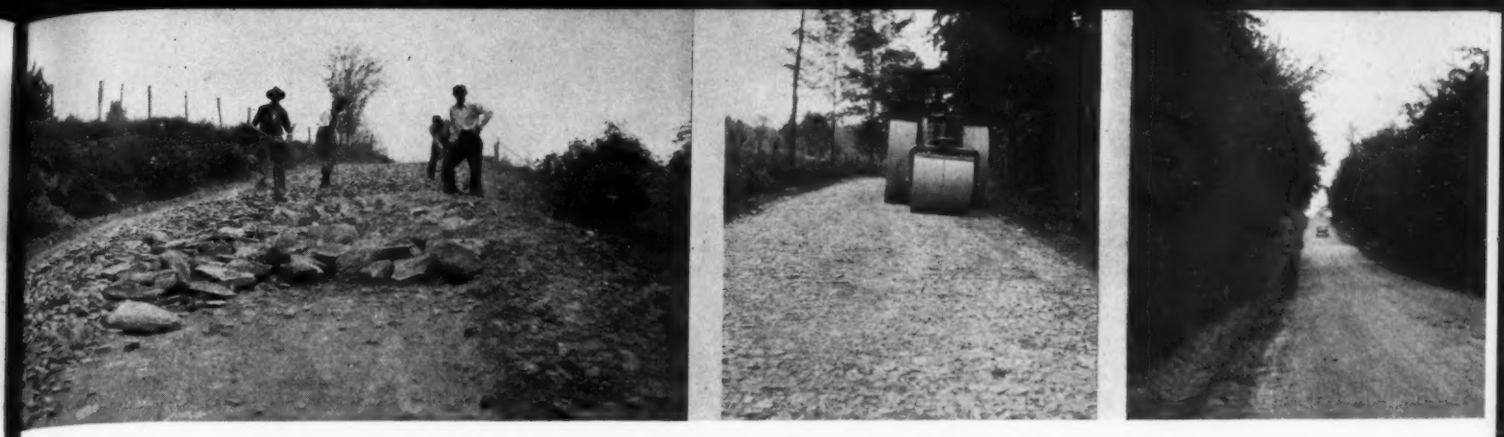
"Coincident with the development of new practices in asphalt road construction came major changes in production. Discovery of new oil fields and development of new refining processes utilizing high temperatures and high pressures to increase gasoline yield resulted in a chaotic situation. Now asphaltic materials are derived from a great variety of crude petroleums of varying characteristics refined by numerous methods. The number of combinations of variables which may affect the quality of the finished product is enormous.

"With the tremendous increase in the use of liquid asphaltic materials, failures of the lower-cost and lower-type surfaces in which they were used has aroused doubt as to their quality. As a result many investigations have been undertaken, new requirements adopted or old ones resurrected, designed to insure materials of satisfactory quality. Among others are requirements for sulphur content, fluidity factor, float-test index, susceptibility factors and ductility at low temperatures. None of these is a true test of quality. While they may exclude some poor materials they will also exclude materials known to be good. Some good materials that will not meet certain restrictive requirements may be made to do so by subjecting them to special processing which does not necessarily improve the product and may definitely injure it.

"It is necessary to know how to measure the weathering characteristics of asphalt; how to determine the factors that affect adhesion between aggregates and asphalts; how poor adhesion may be improved; how to account for peculiarities of asphaltic materials from different sources; and finally, how to handle asphalts during construction to prevent damage. To these problems of constructing adequate bituminous surfaces must be added those which concern the use of asphaltic materials for stabilization. To meet these conditions a national research program should be developed."

What Is a Public Highway?

The Nebraska Supreme Court (City of McCook vs. Red Willow County, 275 N.W. 396) holds that a road constructed by a county leading from a street to a county fair ground and used by the general public only once a year was not a "public highway" or "public way" which the city, within whose limits it lay, could under its charter, pave and improve and levy a special assessment to pay for such improvement.



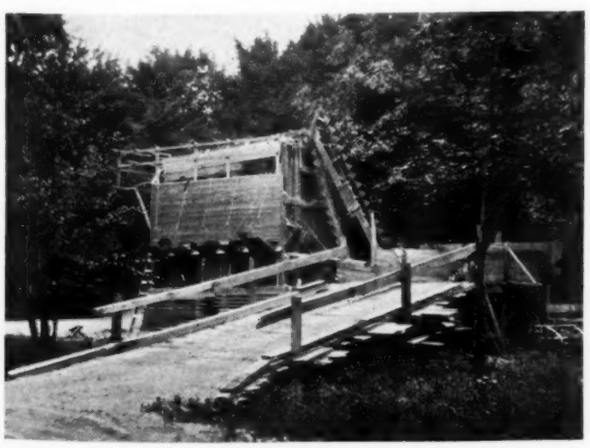
Left to right, placing the Telford base, using field stone; rolling base prior to choking and placing of No. 3 stone; one of the finished roads.

Road Construction in a New York State Township

THE town of Liberty is one of 15 towns in Sullivan county, rural and summer resort section in the Southern Catskills of New York State. (Towns in New York correspond to townships in the Central and Western States.) The town of Liberty is essentially rural; there is one incorporated village—Liberty, of some 4000 inhabitants—and a number of hamlets or unincorporated villages, none of more than 300 or 400 population. During the summer months, there is a very large temporary population, probably two or three times as large as the permanent population, and from July 1st to Labor Day, roads are not torn up because of vacationists, so all road work is done before and after this period.

Main roads are state roads; county roads are principally the secondary and tertiary roads. The residue are town roads. There are 124 miles of these; at the beginning of 1938, 64 miles of these were improved and 60 miles unimproved. Several miles of additional roads will be improved during 1938.

Construction work is entirely by force account, the town maintaining necessary equipment. At the present time, construction and maintenance equipment includes: 3 trucks, 2 of them 2-ton and 1 1½-ton; a "35" tractor; 2 Linn tractors; 3 truck or tractor-drawn graders, 2 of them light and 1 heavy; 1 85-ft. air compressor and drill; 1 1-bag concrete mixer; 2 rollers, both 10-12 ton; 1 broom drag; and 1 stone crusher with a capacity of 10 cu. yds. per hour. Also, a stone or cinder spreader, 5 truck snow plows and 2 special plows for the Linn tractors. This equipment serves two WPA gangs of about 25 men each, and is used in constructing 4.3 miles of road this year.



A field set-up of the stone crusher

Norman H. Rampe, as town highway superintendent, directs the construction and maintenance force. The town highway superintendent is an elective office, but Mr. Rampe, a veteran road builder, has been re-elected consistently (with one 2-year interim) for a number of years. His construction skill and management ability have been important factors in the development of the town road system.

Whenever possible, the work is set up with WPA or other relief labor, and some excellent roads have been built during the past 3 or 4 years by this means, using town equipment and direction.

A bituminous penetration macadam is the standard construction, though other types of surfaces are built, including skin coats and surface treatment on old stone roads, and an oil mat on well-drained dirt. Unless a dirt road is well-drained, a mat or surfacing is useless, since the surface will break badly during the usual severe winter.

The usual procedure in constructing a penetration macadam is as follows: The road is first widened to 16 or 18 feet, using a grader wherever possible and hand work elsewhere. The unimproved roads are usually about 10 feet wide or even less—one-track roads. The alinement is improved where possible, during widening, and culverts and bridges bettered where necessary.

When widening and the associated work is completed, a grader shapes up the shoulders and then cuts back the dirt so that a berm or bank is left on each side to retain the stone when it is placed. These berms are 14 feet apart, so as to give the metaled surface a width of 14 feet. The subgrade is level between these berms.

Upon the subgrade is spread 6 to 8 ins. of coarse stone. This is taken from walls, quarries, ledges, large boulders (broken, by blasting), or other convenient place. Where the foundation is poor or soft, the depth

may be a foot or even more. The stones are broken in place by hand, and then rolled thoroughly until this course is firm and well compacted. Rolling is always from the sides to the center.

This layer of stone forms the foundation course. The necessity for it, and its efficiency are shown by the remarkably few failures of any kind. Traffic on town roads is not, of course, really heavy, though milk, timber, feed, etc., are hauled on both steel and rubber tires. It is rare to have roads of this type require patching within 5 years, despite the severe winters.

The foundation course is then choked with dirt in order to hold up the asphalt and prevent its being lost in the coarse stone. After choking, 675 cu. yds. per mile of No. 3 stone (1½" to 2½") is spread uniformly and rolled lightly. To this is then applied 1½ gallons per square yard of bituminous material—usually cut-back asphalt. This is covered lightly and rolled from the edges to the center. A seal coat is then applied, using 117 cu. yds. per mile of No. 1 stone (¼" to ⅜") and ¾ gallon of asphalt per square yard. This is dragged with the broom drag and rolled.

The result is an excellent riding road of a smooth, close texture, with very little crown. It is admirably adapted to the needs of the community.

The crusher is an important factor in construction and maintenance. This is moved about once a year to a ledge, and then operates continually (for as long as needed), the product being stored in stockpiles. When a construction job is started, extra trucks are hired, a shovel for loading the stone from the stockpile to the trucks is rented, and the work moves quickly. Working an 8-hour day, the crusher will turn out about 80 tons of stone. Ledges of high quality stone are scarce, but by using the better stone for the wearing surfaces, this is no real handicap.

An Arch Bridge of Unusual Construction

A BRIDGE under construction by the California Division of Highways across Big Creek on the San Simeon highway about 50 miles south of Carmel, Calif., is unusual in that the end half-arches are cantilevered or held back by tieing to the main portion of the bridge, without any end piers, the ends of the half-arches being connected to the ground surface by girder spans. The bridge is 500 ft. long and 90 ft. above the bed of the creek.

The reason for this construction is that the ground at the ends of the bridge consists of a considerable depth of loose rock of a character which is unsuitable as foundation material for the ordinary type of bridge. To construct supporting piers for the ends of the structure would have been uneconomical and unsafe, since preliminary investigation indicated that the material would undoubtedly slide. To overcome this difficulty the end spans are tied back to the middle portion of the bridge which rests on large piers so constructed in the solid material as to provide permanent firm anchorage.

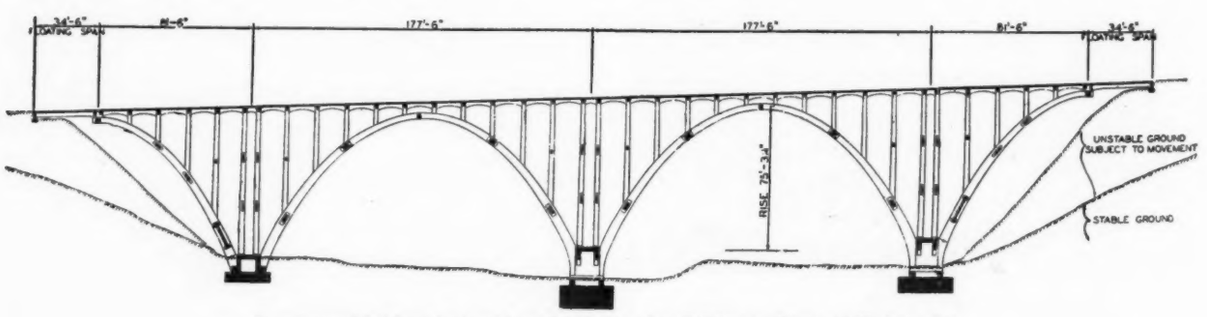
The structure consists of two central spans open spandrel arches each 177-feet, 6-inches in length. At either end of these arches there is an 81-foot, 6-inch cantilever, or tied-back arch, and a 34-foot, 6-inch concrete girder span. The bridge will provide a 24-foot roadway between curbs. The end spans of the arch, instead of resting on abutments, are supported by steel eye-bars which extend the full length of the arch span and are located in the outside girders. The stress in the eyebars is transmitted from the cantilever arches — or the end span arches—by means of steel brackets around which the concrete is poured in the arch rib.

The steel ties are prestressed for full dead load by means of toggle joints and 125-ton hydraulic jacks which are placed at the center pier. When there is no live load, such as highway traffic, on the bridge, the end spans are tied through the bridge to each other and balance themselves. When there is an unbalanced live load, such as a heavy truck on one end of the bridge, this unbalanced load is supported by transmitting the stresses through the eye bars to the main piers, which are designed to take care of such unbalanced live load.

From the ends of the cantilever spans are two short girder spans 34 ft., 6 in. long, which rest on the ground and are fastened to the main structure by hinges. This arrangement is provided so that if the ground should move the span will revolve about the hinge, and there will be no ill effect on the main structure.

For the forms the contractor elected to use plywood. All the rib and column forms were laid out accurately on the ground and later erected in place. The use of plywood accompanied by this careful procedure will result in smooth concrete surfaces and lines. To keep construction joints to a minimum, the arch columns were poured the full length in one operation in order to obtain a smooth concrete surface without unsightly joints. Because of the proximity to the ocean, and the deterioriating effect of salt water and air, great care was taken in designing the concrete mix to secure as dense and strong a concrete as possible.

The Big Creek Bridge, costing approximately $146,000, will be completed about September 1st. C. O. Sparks and Mundo Engineering Company are the contractors.



An unusual bridge designed and built by the California Dept. of Highways

The Editor's Page

Keeping in 1938 Styles With Highway Work

After reading current non-technical literature, we have come to the conclusion that no state, county or city can be in style unless it is (a) carrying on a highway safety campaign; and (b) carrying on a campaign against the social diseases. Those are two fine projects, and since we all like to be in style, this will be a short suggestion as to what to do under (a), above, with especial reference to those little details that the practical man has to tend to while listening to the tremendous and awe-inspiring projects that others talk about.

Jogs, offsets, sharp turns and bad intersections abound in every city, town and village; also in counties and, strange to relate, on state highways. This suggestion having to do with small projects, we'll limit it to cities and villages. Why not make a survey of the community, with especial reference to recently annexed areas, and those sections that have built up rapidly in the past two or three years, and check off the places where a little work would improve highway safety and convenience. There are always more curb corners to round off to longer radii; even at angles in street lines the curbs should be curved (an automobile can not turn at an angle); there are all sorts of snaky wiggles in streets; too many streets don't quite make straight connection with others (this can be remedied by rounding the curbs to make a reversed curve); too many bad intersections. Send an observant young man out on foot with a notebook; work these up for the WPA or the PWA, and get some of these unemployed busy. And, naturally, it's far cheaper to do this now than it will be later, when the little additional right of way needed will cost more, as the areas become more built up.

Why Good Water Meters Are A Paying Investment

Because PWA is with us again, the public works industry is faced with the problem of price vs. quality. The rules of the PWA require competitive bidding and the award of the contract to the low bidder. In general, this is a sound and necessary policy, but it should never be allowed to interfere with the primary aim of construction, which is to secure the best possible job within reasonable limits of cost.

The purchasing of water meters seems to offer a particularly difficult problem to many engineers. On PWA work, and indeed on many other jobs, a number of engineers, to avoid the appearance of favoritism, specify practically nothing about the meters to be used except the size and number. This results in purchase on a price basis only, with the buyer getting the cheapest grade of merchandise in the market.

When cheap meters are used troubles will include: maintenance difficulties and early failures, added cost of servicing, and inaccurate registration. The meters wear noisy quickly, repairs become necessary before they should, and the need for repair parts and necessity for replacement follow—after 10 years of service perhaps instead of 20 or 25 years. Even more important is a possible 10% or more underregistration, unless a costly maintenance program is adopted. Considering the fact that so many of the recent PWA jobs involve relatively small communities, it may be taken for granted that maintenance, repair and testing will not be of a highly skilled type, that replacements will not be made while the meter registers at all, and that even testing may be overlooked for long periods.

A community of 1,000 persons will use about 70,000 gallons per day. If the rate is 30c per thousand gallons and meters register only 4% under—a very optimistic assumption for a cheap meter after a relatively short period of service—the community loses 85 cents per day, or about $305 per year. After a few years, the underregistration may amount to 10%, or even more; with a 10% underregistration, the loss on 70,000 gallons per day is about $765 per year, and the city fathers commence to show signs of extreme worry over water works finances. The only income that a water works department has is what it gets by selling water; and it must pay its bond interest, retire its bonds and operate on this income.

Meters slow down because of wear and increased resistance to the flow of water through them. Wear brings an increased clearance between the disc and the chamber, allowing water to pass through which is not recorded. Increased resistance in the gear train, stuffing box or register gives the disc or piston more work to do, requiring greater water pressure and permitting more water to slip through the clearances due to wear. And a meter so worn or corroded that it underregisters even 5% with a flow of 1 gal. per min. is not likely to register at all with a flow of one-fourth gal. per minute (Ford Meter Box Co.). Thus more water may be lost than would be indicated by the amount of underregistration, as slow or small leaks or flows will not appear at all.

In the small community, where after-care, maintenance and replacement will be limited materially, it is important that good meters be installed. The cost of doing so is not great. We are informed that the initial cost of a top-notch meter is perhaps $1 more than that of a meter sold on competition alone. In the community of 1,000, using about 250 meters, the extra cost for first class meters would be small initially—less than the income that would be lost in one year with a short registration of only 4%.

What has been said here about meters applies with equal force to other equipment that enters into water supply and purification, sewerage and sewage treatment and highway construction. Specifications can be prepared for many items necessary in such construction on which award to the low bidder is desirable and proper; but there are many qualities which are vitally necessary to good performance that are not easily susceptible of description and specification, and there the good judgment and courage of the engineer is badly needed.

Safety in Maintaining Sewers and Sewage Treatment Plants

By LE ROY W. VAN KLEECK

Senior Sanitary Engineer, Connecticut State Department of Health

FEW sewage plant operators or sewer maintenance crews employ the proper safety precautions to avoid the ever increasing hazards from gases and fumes. Certain gases may cause serious fires, may explode when mixed in certain proportions with air, or may asphyxiate or poison men exposed to them. Modern civilization with its accompanying increase in gasoline consumption, fuel gas mains, deep sewers, and industrial activities is making the safe operation of sewers and treatment plants increasingly difficult each year.

While gas hazards have long been recognized by safety engineers, the average individual still has little conception of the potential danger lurking underground in our cities. The list of recent fires and explosions that have occurred at sewage treatment plants and in sewers published last year by a sub-committee of the Advisory Engineering Council is in this connection most illuminating.

Detection of Dangerous Atmospheres

Sewers may contain sewer gas, illuminating gas, gasoline or any of a number of industrial gases. Many of the more common industrial gases, such as ammonia and sulphur dioxide, may be detected by odor. Such gases may be toxic; others explosive. In some cases special tests are required to detect them. Under most conditions, however, industrial gases are not a continuous, usual or serious problem in sewers. The presence of odor or irritation to the eyes or respiratory tract should always be heeded, when tests for the commoner gases have failed to reveal the nature of the gas.

In addition to the gases listed above, sludge digestion tank gas (sewage gas) and chlorine may be encountered around sewage treatment plants. Chlorine may be detected by odor in concentrations as low as 3.5 p.p.m. and chlorine leaks may be located with a bottle of aqueous ammonia, white smoke indicating a leak. Since sludge digestion tank gas and sewer gas are synonymous, the tests suggested below for sewer gas may be used to determine the condition of the atmosphere in sludge tanks, septic tanks, or other subterraneous structures where this gas may be present.

To detect sewage gas† it is necessary to test for hydrogen sulphide, methane and oxygen deficiency. Carbon dioxide is not likely to be present in dangerous amounts unless there is already a deficiency of oxygen.

Hydrogen sulphide detectors developed by the U. S. Bureau of Mines are on the market giving the actual percent of gas present. Their cost is reasonable. Hydrogen sulphide may also be detected qualitatively by moistening a piece of filter paper or cotton with a 5% (by weight) solution of lead acetate and suspending the paper or cotton in the atmosphere under test for 5 minutes. A color varying from grey through brown indicates the presence of this gas and men should not enter such atmospheres without proper respiratory equipment or until thorough ventilation has been instituted with a portable blower or by other means. This gas is not only exceedingly toxic but is also explosive.

Methane and oxygen deficiency may be detected by the use of a Wolf oxygen deficiency indicator using a sampling hose with aspirator bulb and flame arrester. The ordinary Wolf safety lamp should not be lowered into sewers. Methane is non-toxic but serves as a me-

† Sewage gas or sewer gas as found in sewers is a mixture of gases, containing varying amounts of carbon dioxide and methane, a low percentage of oxygen (insufficient to support life) and sometimes hydrogen sulphide. Small amounts of other gases are also present. This mixture is produced as a result of the decomposition of deposited organic matter.

Common Dangerous Gases Likely to Be Encountered in Sewers, Testing Pits, and Around Sewage Treatment Plant Structures in Connecticut

(Further data on these gases are shown in table opposite. Other gases are mentioned on p. 22.)

1 *Name of Gas*	2 *Chemical formula*	3 *Specific gravity or vapor density*	4 *Maximum amount in air without causing serious disturbance in 60 min. (% by vol.)*	5 *Explosive Range of Gas* (% by volume in air)* *Lower limit*	*Upper limit*
Hydrogen sulphide	H_2S	1.19	0.02 to 0.04	4.3	46.0
Methane	CH_4	0.55	Probably no limit if oxygen is sufficient for life.	5.0	15.0
Carbon dioxide	CO_2	1.53	4.0 to 6.0	Not inflammable	
Nitrogen	N_2	0.97	——	Not inflammable	
Oxygen (in air)	O_2	1.11	——	Not inflammable	
Carbon monoxide	CO	0.97	0.05	12.5	74.2
Hydrogen	H_2	0.07	——	4.0	74.2
Gasoline	C_5H_{12} to C_9H_{20}	3.0 to 4.0	0.43 to 0.71	1.3	7.0
Chlorine	Cl_2	2.49	0.0004 (4 ppm)	Not inflammable	

Sludge digestion tank gas consists principally of CH_4 and CO_2. H_2, N_2, H_2S, O_2 and occasionally CO and PH_3 are present. (3) and (4) vary with composition. (5) is 5.3 and 19.3 respectively.

*"Explosive range" refers to the definite limitations of combustibility and rate of burning of flammable gas or vapor mixed with the air. When the particles are so widely separated that those set on fire by the igniting medium will not set fire to others that are nearest, the mixture is called too "lean" for combustion, and will not burn. When the particles are so close together that they exclude the oxygen necessary for combustion, the mixture is called too "rich," and it will not burn. The concentration, or per cent by volume, between the leanest and the richest mixtures that will burn is called the "explosive range." Between these limits will be found various phases of slow or rapid combustion.

Name of Gas	6 *Common Properties (Percentages given below are percent in air by volume)*	7 *Physiological Effect (Percentages given below are percent in air by volume)*	8 *Likely Location of Greatest Concentration*	9 *Commonest Sources*	10 *Methods of Testing*
HYDROGEN SULPHIDE	Rotton egg odor in small concentrations. 2-15 mins. exposure to 0.01% impairs the sense of smell. Odor not evident to human beings at high concentrations. Colorless. Inflammable. Explosive.	Impairs sense of smell rapidly as concentration increases. Death in few minutes at 0.2%. Exposure to 0.07 to 0.1% rapidly causes acute poisoning. Paralyzes respiratory center.	Near bottom of structure, but may be above bottom especially if the air is heated and highly humid.	Coal gas, petroleum, sewer gas.* May occur in fumes from blasting under some conditions. Sludge digestion tank gas.	1. Lead acetate solution (Qualitative). 2. Hydrogen sulphide indicator (Quantitative).
METHANE	Colorless, odorless, tasteless, non-poisonous. Inflammable. Explosive.	Acts mechanically to deprive tissues of oxygen. Does not support life.	Normally at top increasing to certain depth.	Natural gas, sludge digestion tank gas, manufactured fuel gas, sewer gas*. Strata of sedimentary origin. In swamps or marshes. May be present in sewers, screen chamber rooms, or in confined areas where sludge gas piping may leak.	1. Combustible gas indicator or detector. 2. Oxygen deficiency indicator (commonly known as the flame safety lamp).
CARBON DIOXIDE	Colorless, odorless, when breathed in large quantities may cause a distinctly acid taste. Non-inflammable. Will generally not be present in dangerous amounts unless there is already a deficiency of oxygen. The oxygen indicator (flame safety lamp) is therefore suggested under tests.	10% cannot be endured more than a few minutes, even if the subject is at rest and oxygen content remains normal. Acts on nerves of respiration.	At bottom but when heated may be stratified at points above the bottom.	Products of combustion, sewer gas*, sludge digestion tank gas. Also issues from carbonaceous strata. May be found in sewers.	1. Oxygen deficiency indicator, commonly known as flame safety lamp.
NITROGEN	Colorless, tasteless. Non-inflammable. Principal constituent of air (about 79%).	Physiologically inert.	Near top but may be found near bottom.	Sewer gas.* Sludge digestion tank gas. Also issued from some rock strata. May be found in sewers.	1. Oxygen deficiency indicator. See remarks in "Common Properties" column for carbon dioxide.
OXYGEN	Colorless, odorless, tasteless, non-poisonous gas. Supports combustion.	Normal air contains 20.93% of O_2. Man will tolerate down to 12%. Below 10% dangerous to life. Below 5 to 7% likely to be fatal.	Variable at different levels.	Oxygen depletion from poor ventilation and absorption or chemical consumption of available oxygen. This condition is likely in sewers, sludge digestion tanks, and confined areas.	1. Oxygen deficiency indicator.
CARBON MONOXIDE	Colorless, odorless, tasteless, non-irritating. Inflammable. Explosive.	Hemoglobin of blood has an affinity for CO approx. 300 times greater than for oxygen. 0.2-0.25% unconsciousness in 30 mins. 0.1% fatal in 4 hrs. 0.02% headache in few hours.	Near top, especially if present with illuminating gas.	Manufactured fuel gas, flue gas, products of combustion, motor exhausts. Fires of almost any kind. May therefore be present in sewers, screen chamber rooms, etc. Has occasionally been reported in sludge tank gas.	1. CO ampoules. 2. CO indicator. 3. CO detector. 4. Canary or mouse.
HYDROGEN	Colorless, odorless, tasteless, inflammable.	Acts mechanically to deprive tissues of oxygen. Does not support life.	At top.	Manufactured fuel gas, sludge digestion tank gas, electrolysis of water. Sometimes from rock strata (rare). May be found therefore in sewers, screen rooms, etc. In digestion tanks not likely to reach lower explosive range.	1. Combustible gas indicator. 2. CO test (if from fuel gas).
GASOLINE	Colorless, odor noticeable in 0.03%. Inflammable. Explosive.	Anesthetic effects when inhaled. 2.43% rapidly fatal. 1.1 to 2.2% dangerous for short exposure.	At bottom.	Motor vehicles, storage tanks. May be found in sewers, screen rooms, etc., from discharges of garages, dry-cleaning establishments and homes.	1. Combustible gas indicator or detector. 2. Oxygen deficiency indicator for concentrations over 0.3%. (Use instrument in fresh air.)
CHLORINE	Yellow, greenish gas, choking odor detectable in very low percentages. Non-inflammable.	Irritates respiratory tract. 0.1% kills most animals in very short time.	At bottom	Chlorine cylinder and feed line leaks.	1. Odor generally gives ample warning unless heavy concentration is breathed at once. 2. Check for leaks with bottle of aqueous ammonia.
SLUDGE DIGESTION TANK GAS	May be practically odorless, colorless. Inflammable, explosive.	See remarks on individual gases. Toxic. Will not support life.	Near top of structure.	From digestion of sludge in tanks.	See remarks under individual gases.

*Mixtures containing abnormally high percentages of carbon dioxide, varying amounts of methane, low percentages of oxygen and sometimes hydrogen sulphide have been termed by some as "sewer gas." These mixtures sometimes accumulate in sewers as the result of fermentation or decomposition of deposited organic matter.

Dangerous Gases Which May Be Encountered Occasionally

1. Ammonia (NH_3). Commonest source would be from refrigerating plant leaks. It might therefore be found in sewers or confined areas at sewage treatment plants. Specific gravity 0.60, therefore located near top of structures. It is explosive in the range of 16.5 to 26.8% in air. The maximum amount tolerated for 60 minutes without serious disturbances is 0.03%. It is very irritating to the respiratory tract and eyes. It is colorless and its strong characteristic odor even in very low concentrations constitutes a satisfactory method of detecting its presence.

2. Sulphur dioxide (SO_2). Commonest sources would be from burning insulation and from industrial processes using sulphur or sulphur compounds. It might therefore be found in sewers or confined areas at sewage treatment plants. It does not burn or support combustion. Specific gravity 2.26 so it usually will be found at the bottom of structures. The maximum toleration to the gas for 60 minutes without serious disturbances is in a range between 0.005 to 0.02%. The gas irritates the respiratory tract membranes; it is colorless and its strong penetrating odor even in very low concentrations is a suitable method for detection.

3. Phosphine (PH_3) may be generated occasionally in sludge digestion tanks as reported by Jones of the U.S. Bureau of Mines and others. The gas is colorless, has an odor of decaying fish, ignites at 100°F. and has the peculiar property of taking fire spontaneously when in contact with air. It is poisonous. Specific gravity 1.18. The positive exclusion of air from digestion tanks at all times is necessary to remove the fire hazard from this gas. Temperatures of 100°F. or greater are most likely in summer.

4. Ethane (C_2H_6). Commonest source would be from manufactured fuel gas. It might therefore be found in sewers or confined areas at sewage treatment plants. Ignition temperature is between 950-1166°F. Specific gravity 1.05, therefore likely to be found near bottom. It is explosive in the range between 3.1 and 12.5 in air. The gas is inert physiologically but may cause suffocation because of displacement of oxygen. In general it is similar to methane and of the same CH_2 group. The carbon monoxide test for illuminating gas serves as a rough check for the presence of ethane when fuel gas is the source and fuel gas is the most likely source of ethane in sewers.

chanical diluent for oxygen. It is explosive and is the principal combustible in sludge tank gas. It is detected with the Wolf indicator by an increase in flame height or an increase in flame height followed by the extinguishing of the flame. The latter situation is the more dangerous. It is important to bear in mind, however, that this indicator will react with any combustible gas that may be present, including appreciable quantities of gasoline or manufactured illuminating gas. Natural gas being principally methane is also detectable with this device. The presence of any combustible gas constitutes an unsafe atmosphere and men should not enter without respiratory protection or until thorough ventilation has been employed. When combustible gas atmospheres are entered all sources of ignition must be avoided.

Many cases of so-called gas poisoning or asphyxiation have resulted not from toxic gases but because insufficient oxygen was present to support life. The flame of the Wolf indicator will usually be extinguished by an atmosphere containing much less than 17% of oxygen and always by one containing less than 13% (by volume) of oxygen. An atmosphere containing 12% or less of oxygen is considered decidedly dangerous to man. Normal air contains roughly 21% oxygen. It can readily be seen that this indicator is a suitable device for detecting atmospheres deficient in oxygen, and it should be regularly used by sewer maintenance crews and others before entering deep manholes or other subterraneous structures. This device may be purchased through safety equipment manufacturers.

Combustible gas indicators mentioned later are also suitable for detecting methane. They are more accurate but are also more expensive.

To detect manufactured illuminating gas leaks in sewers or subterraneous structures a test should be made for carbon monoxide. Manufactured gas is principally a mixture of methane, hydrogen and carbon monoxide and a test for carbon monoxide is usually sufficient evidence that manufactured gas is present. Manufactured illuminating gas is both toxic and explosive.

Carbon monoxide ampoules may be purchased in small packages at very reasonable cost. The ampoules contain a chemical solution which darkens on exposure to the gas. A color scale is provided giving the concentration to 0.1% by volume.

Carbon monoxide detector sets are also available, these reading with the use of a color scale to 1% of gas by volume with air. Samples of the gas are brought in contact with a detector tube using a sampling hose and aspirator.

Carbon monoxide indicators are also carried by the leading manufacturers, these latter determining electrically the percent of gas present. They are very sensitive to low concentrations but their greater expense seldom justifies their purchase by sanitary workers. The ampoules, detector sets and indicators for carbon monoxide may all be purchased from safety equipment manufacturers.

To detect gasoline vapor in sewers or around sewage plant structures the oxygen deficiency indicator mentioned in connection with sewage gas may be used to determine concentrations over 0.3% by volume with air. This concentration is below the explosive range for gasoline but a more sensitive device, and one which safe practice dictates, is a combustible gas indicator. This measures electrically the actual percent of combustible vapor present. Several safety equipment manufacturers have recently brought out small indicators at very reasonable prices which are very suitable for work in the sanitary field. While these small indicators are calibrated for a single gas or vapor (such as gasoline) they will of course react with any combustible gas which may be present. Since it is more important to know that *a* combustible gas is present rather than *what* combustible gas, this cannot be considered a serious disadvantage. In dealing with gasoline it should be remembered that the vapors of this liquid are not only explosive but also toxic.

Safety equipment of value in sewer maintenance and treatment plant operation will be described in an early issue.—Editor.

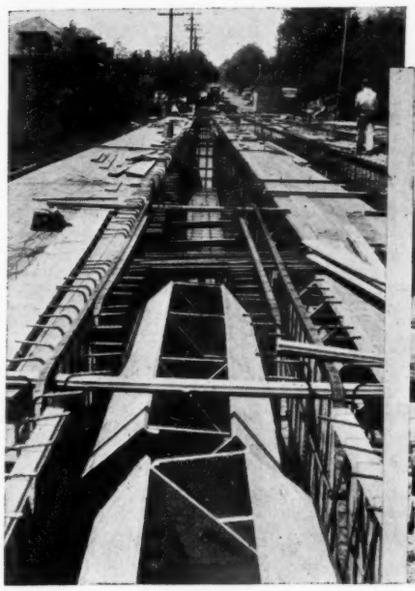
Pedestrian Regulation on State Highways

The laws of all but 10 States contain some provisions concerning the rights and duties of the pedestrian. In 30 States he is required by statute to obey traffic control signals at intersections. At intersections where such signals are not in operation, a pedestrian on a marked or unmarked crosswalk has the right of way over vehicles in 28 States.

Where traffic control signals are in operation at adjacent intersections, it is unlawful for pedestrians to cross the roadway between intersections in 23 States. Where such signals are not in operation at the adjacent intersections, the pedestrian may in 32 States cross the road at any place, but must yield the right of way to all vehicles.

In 17 States pedestrians are forbidden to stand in the roadway for the purpose of soliciting a ride; and in 4 States to sell or beg in the roadway.

Twelve States have enacted legislation requiring pedestrians to walk to the left on the highway in order to face oncoming traffic. These laws are sometimes expressly declared to be safety measures only, and have been generally considered by the courts as a safety policy and not mandatory, thus avoiding the necessity of finding the pedestrian negligent when he is injured while walking on the right side of the road.



Form for hollow girder; "banana crate" forms left imbedded in the concrete.

View of piers Nos. 2, 3 and 4 from beneath finished structure.

Steel in place for a Mesnager hinge; also cross strut between hinges.

Concrete Bridge 344 Feet Long Without Expansion Joints

By S. C. WATKINS
City Engineer, Aberdeen, Wash.

A LARGE part of the finest residential area of Aberdeen, Wash., is on bench land and is divided by a steep-sided ravine 40 ft. deep below street level and over 300 ft. wide on top. This had to be bridged, and a wooden trestle carrying a two-lane roadway was built in 1910; but a more permanent construction became desirable and it was replaced recently with a concrete structure which embodies several interesting features.

The new structure carries a 3-lane roadway 30 ft. wide and two 5 ft. sidewalks separated from it by curbs 14″ wide by 12″ high, with pipe railings carrying a heavy wire fencing. The total length is 344 ft., consisting of four 73 ft. spans and two 26 ft. cantilevers at the ends. There are four main girders 4 ft. wide, 3 ft. 5 in. deep at midspan and 6 ft. at the supporting bents. An unusual feature is that these are made hollow, wooden "banana crates" in the form of 30 in. octagons 9 ft. 4 in. long being embedded in their centers, separated by spaces 10 in. wide which are filled with concrete which form interior webs or diaphragms. These octagons, being left in permanently, are made with provision for swelling of the wood, the joints between adjoining brands being open and covered with a strip of metal. The columns also are made hollow, and this cellular construction considerably reduces the cost of the bridge. This bridge cost $3.23 per square foot of overall area.

Another interesting feature is that there are no expansion joints in the entire 344 ft. of deck. Instead, the short columns of the end bents were built with Mesnager hinges, forming rocker sections which allow free temperature movement of the ends of the bridge. The lesser movements at the three inner bents, which have long columns on pile foundations in peaty ground, were regarded as inconsequential and were ignored. The hinged columns contained two flexible joints, one 2 ft. 8 in. above the foundation and the other 4 ft. higher, containing an asphaltic filler 1 in. thick, while the column reinforcement bars exchanged sides, crossing each other at the joint so as to form an X. Heavy reinforcement was used and considerable care was necessary in placing the concrete, but the construction was not unduly difficult.

Each of the three center bents has two 5 ft. by 3 ft. columns, the 5 ft. dimension being transverse to the roadway. These columns are 30 ft. out to out, coming flush with the outer sides of the outer girders. The 3-ft. wide cap beam of solid section therefore spans 20 ft. clear between them. The columns are cored with an inner form 18 by 36 in. having its corners chamfered 4 in.

The footings beneath the columns are small at the end bents, which bear on rock, but are unusually large where the pile foundations were employed, the pile load being held to 10 tons for 40 ft. piles and the size of footing being sufficient to cover all the piles. The footings spread out symmetrically beneath the columns, the pair of each bent being connected by a heavy reinforced street.

All concrete is reinforced, the concrete and steel stresses being the customary 1,000 lb. per sq. in.—18,000 per sq in. with $n=10$. The design loading is H-15.

Five bids were received, varying from $47,087.35 to $59,725.00. The lowest bidder, J. B. Lamb, was awarded the contract. This makes the cost $136.87 per lin. ft., or $3.23 per sq. ft. based on the overall breadth.

If roadway, 1 curb and 1 sidewalk are assumed to constitute the breadth, the cost is $3.78 per sq. ft.

Construction Work

Construction progressed according to the following program:

1. Dismantling old trestle and clearing site.
2. Driving bearing piles of Western red cedar for bent foundations, and piling for false work.
3. Excavation around bent piles and cutting off same at permanent saturation line. Footing excavations to solid rock for end bents. Placing forms for all footings.
4. Placing Class B concrete, maximum 3" aggregate, in all footings.
5. Constructing forms for all columns, placing reinforcement and concrete, Class B concrete in the center bent, Class A (1½" maximum aggregate) in all others. In the three center bents, concrete was placed continuously to the bottom of the cap beams; in the end bents, to the bottom of the Mesnager hinges and later extended to the top of the hinges including cross strut between hinges.
6. While columns were setting, falsework and forms for cap beams and girders were constructed and reinforcing steel placed. Concrete in girders and cap beams was placed continuously up to fillet lines at floor slab junction. Concrete mixed in two 1-sack mixes and delivered in buggies, 56 hrs. being required to complete the job, crews working in 6 hr. shifts. One mixer did not stop during the 56 hrs., the other stopped about 5 min. for repairs.
7. While girder concrete was setting, steel was placed for deck and curbs, and forms for curbs and rail post bosses. The walks, roadway deck, curbs and rail post bosses were placed integrally. One shift of 8 hrs. per day was employed. The deck slabs were not placed continuously, but a construction joint was made at the center of the spans. These joints were cleaned and grouted at beginning of the next shift and sealed tightly, as the design placed the concrete in compression at those points. Class A Concrete with 1½" max. aggregate was used on this work.
8. The final stage consisted of placing of railing, removing forms, cleaning up the job and giving Class A finish to all exposed faces of concrete.

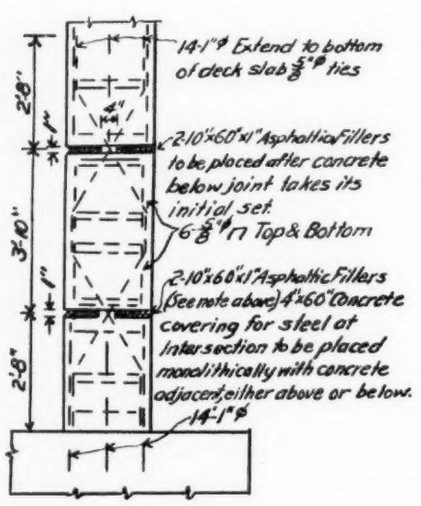
In the placing of all concrete, motor-driven vibrator of the flexible tube portable type was used with excellent results.

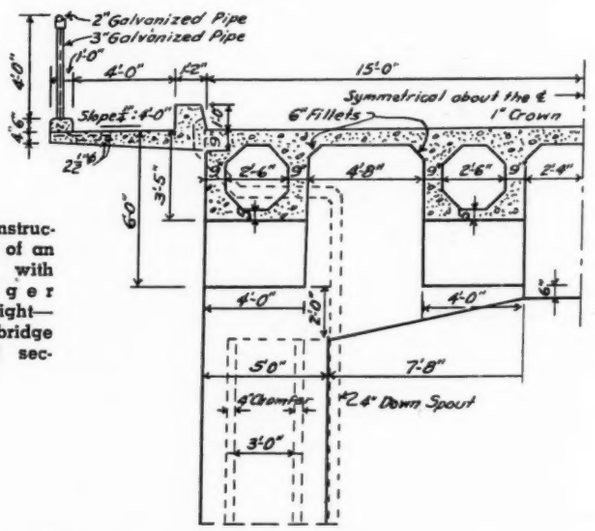
General plans and detailed specifications were prepared by the writer, who also supervised the construction of the structure. Norman Salmon was resident engineer for the city and W. W. Wiley was resident inspector for P. W. A.

The detailed design was prepared by W. H. Witt Co. of Seattle. Since funds for the bridge came not only from L.I.D. assessments but also from gas tax monies received from the State of Washington and from a P.W.A. grant, engineers of both of these authorities checked and approved the plans. Considerable helpful assistance was received from members of the Portland Cement Association staff, for which the writer desires to express his appreciation.

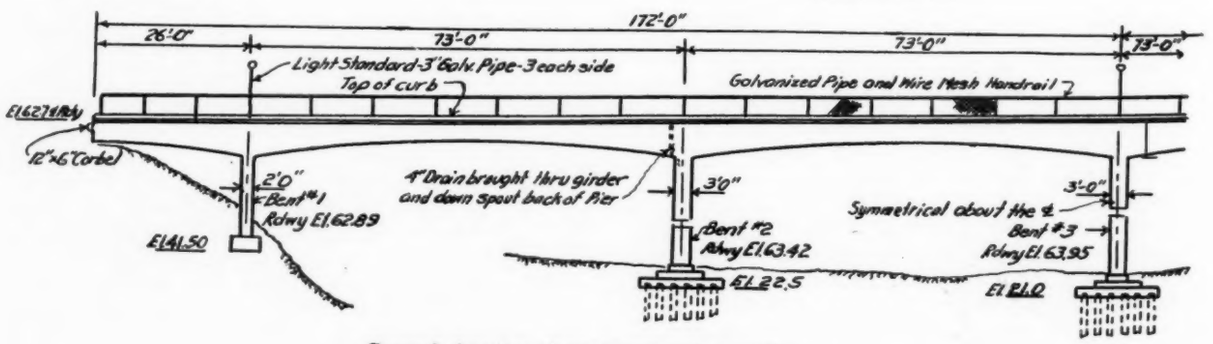
Removal of Highway Obstructions

The Oklahoma Supreme Court holds (Patillo v. Moore Bros. Ice & Milling Co., 73 P. [2d] 842) that the decision of a highway officer that a disabled vehicle is an obstruction of the highway is generally conclusive, except where there has been an abuse of authority or discretion. But after the officer has determined that such a vehicle is an obstruction, he must use due and reasonable care, under the circumstances, in removing the vehicle and its contents.


14-1"ϕ Extend to bottom of deck slab
5"ϕ ties
2-10"x60"x1" Asphaltic Fillers to be placed after concrete below joint takes its initial set.
6-⅝"ϕ rl Top & Bottom
2-10"x60"x1" Asphaltic Fillers (See note above) 4"x60" Concrete covering for steel at intersection to be placed monolithically with concrete adjacent either above or below.
14-1"ϕ
2'8"
3'10"
2'8"

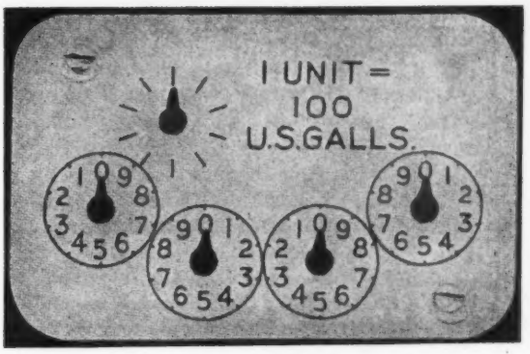


Left — Construction detail of an end bent with Mesnager hinges. Right — Details of bridge floor, half section.



General elevation of two spans and a cantilever.

Meters and Meter Specifications



Standard meter dial of the Central Power & Light Co.

WATER works superintendents—many of them, but not enough—are becoming meter conscious; they are taking their meters seriously and critically. This is indicated, among a number of recent events, by the number of papers on the subject before the New Orleans convention of the American Water Works Association and the interest taken in the round table discussion on Meter Specifications at that convention—also the Water Works Practice Committee is collecting data and opinions with a view to bringing that society's meter specifications up to date.

To place before waterworks superintendents some of the ideas entertained on the subject, we are giving below a composite of those expressed at the New Orleans Convention, especially those by Clem A. Gallagher, superintendent of services, Louisville Water Company; F. W. E. Weisse, superintendent of the meter department, Central Power & Light Co., Corpus Christi, Texas; A. P. Kuranz, superintendent of water department, Waukesha, Wis.; J. A. Mitchell, meter superintendent, Illinois Public Service Co., Champaign; and John L. and Richard V. Ford, sales manager and vice president, Ford Meter Box Co.

First as to accuracy. Hartford tests indicated that, in houses equipped with tank toilets, 27 to 50% of the total amount of water used was at a rate of less than one gallon a minute and 33 to 78% at less than 2 gallons. About ¼ to ⅓ of the water used to fill the flush tank comes into the tank so slowly that it takes a *good* meter to register and record it—2 to 4 gal. per hr. in many cases (.3 to .7 gpm); while leaky toilets run continuously at half this rate. A ⅝ meter in a Waukesha residence was tested by a recording chart for 6 hours and this showed 6 gallons consumed but the meter registered but 1 gallon. Another meter in the same city, tested by a recording chart for five days showed 44% under-registration. The ⅛ inch stream is usually the smallest tested, but Mitchell believes that tests on 1/16 and 1/32 inch streams are desirable.

Ford believes that practically no domestic water is used at a rate of over 3 gpm, and that testing at rates higher than this is a waste of time. He considers as most important what he calls the "breakaway point"—the flow at which the disc begins to move; the meter then jumps from zero registration to well over 50%. This point can not be determined by the ordinary meter tester, but he believes it possible to produce an indicator that will show the *rate* of flow at even the smallest rates. (His firm is working on the development of a special rotameter that will serve this purpose). Only by use of some such rate of flow indicator is it possible to determine the sensitiveness of a meter and its accuracy at very low flows.

Can meters be made at reasonable cost that will register with accuracy at such low flows? Meters are being made that register 85% at 1/16 gpm when new and 80% after having been in service 5 to 6 years. Kuranz believes that "most manufacturers of meters are improving their standards of manufacture, inspection and testing, and that the specifications on tests could and should be written to include the measuring and recording of smaller streams than is now common practice or a higher percentage than 90 per cent on a ¼ gpm flow as well as including other minimum test flows." Says Gallagher: "Water meters can be and are manufactured down to a percentage of inaccuracy of 0.1% instead of 2%, but the evident time and workmanship required will increase the price of such a meter above the prevailing level. . . . Water meters today, within the standard price range, are or can be so manufactured that flows down to 1/12 gpm can be registered at 70% or better."

As to "reasonable" cost. Assuming an average domestic consumption of 150 gallons per day per meter, and that ⅓ of this (see above figures) is used at rates of less than 1 gpm, and that the meter registers only 70% of this and 100% of the balance, we have an under-registration of 5,475 gal. a year. (This is equivalent to only 3⅓% of an average total consumption of 100 gal. per capita per day—a small part of the unaccounted-for water in most cities.) If the rate is 30 cts. per thousand gallons, this means a loss of $1.68 a year for each ⅝ inch meter. Capitalized at 10%, this means that $16.80 additional could be paid for a meter that would register 100% of these small flows, or $8.40 additional for one that would register 85% of all flow at rates less than 1 gpm.

It would appear from the opinions above that such meters can be made if sufficient inducement is offered to the manufacturers. This inducement would take the form of asking for them and willingness to pay for them. As to the latter, the above calculation, if reasonable and properly presented, should convince water departments that a good meter is worth $5 to $10 more than just an ordinary one on registering accuracy alone. But only if it will maintain its accuracy; and ability to do this should be included in the higher price.

Asking for them is a matter of specifications under which they are purchased. And on this point several members had a lot to say—Clem A. Gallagher in considerable detail. Said he: "The A.W.W.A. standard specifications for cold water meters—disc type—are the same as the day when adopted in June, 1921. . . . The waterworks men of today want the specifications to be such that they may be assured of receiving the best meters that their money can buy. Our present specifications do not so assure them. . . . The chaos, ill-feeling, cut-throat competition and dissatisfaction in the meter field today can be traced very surely and honestly to the laxity of the specifications. . . . Today instead of it being difficult

to manufacture a meter to come up to A.W.W.A. specifications, it is very difficult to make a meter that will not fall within the specifications. . . . The manufacturers are years ahead of the present specifications in precision methods and requirements."

Every displacement meter consists primarily of but four parts—measuring chamber, train of gears, register and outer casing. The specifications do not set any minimum or maximum number of revolutions of measuring element per cubic foot measured, size of measuring chamber, or weight of measuring element, although accuracy and durability depend essentially upon them. As to the casing, the specifications call for "bronze composition" only, not even for the "best." The cheapest grade of bronze obtainable, if it will hold together as a casing, meets the specifications. The register and intermediate gears must be of "non-ferrous metals"—a provision against rusting only, although wear, accuracy of gear cutting and assembling, and other features are fully as important.

Under "Registration" the specifications provide only, for a ⅝ inch meter, that it shall not over or under register more than 2% when passing between 1 and 20 gpm, nor record less than 90% at ¼ gpm. Mr. Gallagher "would not consider for purchase a ⅝ inch meter that would not record 95% or better at ¼ gpm."

The registers were given special consideration by Mr. Weisse, who showed a photograph of 8 different designs. If several are in use in one city "The meter reader, having a so-called frosty or foggy glass (over the register) cannot readily determine the starting point, or in other words the lowest selling value pointer circle. Again, on your so-called straight reader you will find that should the register be on a turning point it is practically impossible to determine the proper figure." His company also sells electric current and finds that 26,000 water meters give more trouble and confusion than the 90,000 electric meters, the registers of which are standardized. His company is standardizing the water meter registers, and he recommends that the standard specifications do so also.

With so little encouragement, it is greatly to the credit of the meter manufacturers that they have developed their product far beyond the requirements of the specifications; and of waterworks superintendents that so many of them appreciate this high quality. Is it not about time this high quality be encouraged, and that cheap meters be permitted to compete with the high-grade ones only where cheap ones are wanted and knowingly asked for? With such recognition of the improvements they have already made, the leading manufacturers may develop still others, until even the contemplated "new" specifications become out of date. But unless they are so encouraged, what inducement have they to maintain their present standards and refrain from yielding to the pressure to sell on a price rather than a quality basis?

Bases for Rating of Illinois Swimming Pools

In rounding out and making more complete the Illinois Department of Public Health's swimming pool program, this summer, Certificates of Classifications are being issued to each outdoor pool. These certificates show the sanitary rating of that pool based upon the department's minimum sanitary requirements, which cover the four main headings of POOL FACILITIES, BATHHOUSE FACILITIES, WATER TREATMENT and OPERATION. During the past two years pools have been advised of the changes necessary to meet the minimum requirements and because of the number of improvements which have been made in many of the pools, it is felt that due recognition should be given to those pools that are trying to furnish the public safe swimming facilities. Realizing the competition which exist in this field, it is believed that this method will stimulate improvements by those pools which do not have as high a sanitary rating as others in their community. In addition to the issuance of this certificate, each pool owner receives a detailed scoring sheet on which the rating for his particular pool is based and thus the pool owner can determine what improvements are necessary in order to raise the sanitary rating of that particular installation. The issuance of this certificate, combined with the State-wide educational program whereby the patrons will know the sanitary rating and the defects at the particular pool he is patronizing, will, it is hoped, result in the improvement of swimming pool facilities in Illinois. The complete department's swimming pool program consists of routine inspection and analyses of all swimming pool facilities by sanitary engineers, receiving operation reports from such pools, the holding of sectional swimming pool operators meetings in various parts of the State and the issuance of a quarterly publication, the New Swimmin' Hole, to swimming pool owners and operators, which discusses their pool operation problems.

The scoring sheet upon which the rating is based contains the following items:

Pool Facilities	*Perfect Score*
1. Proper fence or barrier	4
2. Spectator provisions	2
3. Walk drainage	4
4. Overflow drainage	4
5. Type of overflow	3
6. Adequate walk area	2
7. Depth proportions	1
	20
Bathhouse Facilities	
1. Shower facilities (warm water)	7
2. Toilet facilities, (wet, dry, spectator's)	6
3. Floor drainage	2
4. Cleaning facilities	3
5. Lighting and ventilation	2
	20
Water Treatment	
1. Rate of turnover (8 hr. or less)	9
2. Rate and disposition of wash water	4
3. Water supply connection	6
4. Chemical application	3
5. Adequacy of disinfection and application	9
6. Hair strainer	2
7. Suction cleaner	2
	35
Operation	
1. Clarity of water	4
2. Inspection of bathers	5
3. Suit requirements (disinfection)	4
4. Condition of bathhouse	3
5. Condition of pool area	3
6. Adequacy and qualification of staff	4
7. Records and reports to State	2
	25
TOTAL	100

Classification Schedule

AA	95-100
A	85-95
B	75-85
C	65-75
D	Not approved

Financing Sewage Disposal by Charges for Sewerage Service*

By CARL W. FRANK
City Engineer, New Ulm, Minn.

THE use of sewer rental charges has been slow in developing but is now well out of the experimental stage. Federal aid for self-liquidating projects brought about enabling acts in several states. There are thirty-two states which have enabling acts. In twenty-five of these states cities are taking advantage of the act. Of the sixteen states without enabling acts there are seven states in which cities are charging sewer rentals either through special charter provisions or through interpretation of the general laws.

The laws of the several states vary as to the use which can be made from the sewer rental income. Most of the laws are worded to the effect that any surplus over what is necessary for maintenance, operation and repairs may be used (1) for interest on indebtedness, and (2) for the retirement of bonds.

Basis for Charges

Three methods are used as a basis for making sewer rental charges: (A) the amount of water used; (B) a flat rate; and (C) the character of the sewage. The main factors may be outlined as follows:

A. Charges Based on the Amount of Water Used
1. A graduated scale of rates depending upon the quantity of water used as shown by the water meter reading and an estimate where no meter is installed, or where the user has a private water supply. A minimum charge is usually provided.
2. A two-part rental.
   a. A ready-to-serve fee graded according to the size of the service or meter installed, or some other basis.
   b. A graduated scale of rates depending upon the quantity of water used or on estimates as in A-1, or on a uniform rate as in A-3, or a percentage of the water bill as in A-4.
3. A uniform flat rate for all water consumed.
4. A percentage of the bill for water.

B. Charges Based on a Flat Rate
1. A flat rate per house connection with an approximately equivalent corresponding rate for apartment houses, industries and other types of property or business.
2. A scale of rates depending upon the number and kind of fixtures connected to the sewerage system.
3. A combination of B-1 and B-2.

C. Charges Based on the Character of Sewage.
1. A schedule of charges depending on the degree of pollution as measured by the relative amount of suspended matter, the biochemical oxygen demand, or some other factor together with the quantity of water consumed, or number and type of fixtures, or the type of connection as to size, type of property, etc. (Method A-1 can be used in municipalities where all or most of the water consumed is metered by the municipality's water department.

This last is the most equitable method available. The work and expense involved prevent it, however, from being advantageous from an administrative point of view in most instances. There may be cases where an industry disposes of more suspended matter than the rest of the entire community, while the water consumption may be small proportionally. In this case a charge based upon water consumption would not be adequate or equitable.

*From a paper presented at the School for Operators, University of Minnesota.

The problem of determining a schedule of sewer rental charges cannot be solved by definite rules. The problem in each municipality must be studied separately. The method must suit local conditions; it must provide adequate revenue; expense of administration must be held at a minimum; and the cost to all users must be as fair as possible.

Some Disadvantages

The disadvantages advanced in regard to sewer rental charges are summarized in a paper by Frank A. Marston, as follows:

It is difficult to gain public approval of such a plan unless a new sewerage system or sewage treatment plant is just being started.

Such a system requires clerical assistance and involves expense and other complications of administration.

Some property owners prefer to pay one bill for taxes rather than to have a separate bill for sewerage service. Some property owners may delay making a sewer connection, until forced to do so by ordinance, because of the desire to escape the annual charges.

Service charges cannot be billed until the sewer connection has been made and the sewer is ready for use, and any unforeseen delays in construction may delay the receipt of funds, thereby throwing an unexpected burden on other sources of revenue.

A residential community may not require the various classifications of service justified in an industrial city and for that reason the complications of a service charge system may appear unwarranted.

The municipality as a whole should bear a substantial part of the cost of operating the system.

Advantages to Be Gained

The advantages to be derived from a system of annual charges are enumerated by Mr. Marston as follows:

Funds can be provided continuously and adequately to insure efficient operation and the best service.

The source of revenue will not be in direct competition with other more popular budget items in the tax levy.

The funds will not be subject to economy cuts at the whims of disinterested officials.

Each property owner will pay a fair share of the cost in accordance with use.

Taxpayers having no sewerage facilities will not be required to pay for maintaining the service rendered others.

The sewerage works can be maintained in efficient condition and thereby avoid waste of public property.

Keeping the sewage treatment plant in good operating condition will avoid the danger of lawsuits because of pollution from the discharge of untreated sewage or other nuisance that might result under conditions of bad operation.

The availability of funds will permit engaging trained operators and adequate labor, thus ensuring good operation.

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The sewerage system will be a self-supporting public utility comparable with the water system.

Funds will be limited in use to the purposes intended and cannot be diverted to other municipal departments.

Administration and Billing

The difficulties encountered in the collection of sewer rental charges have not been very great. In some cities separate bills on different dates from the water bills have been used. However, this practice has been discontinued in most instances on account of the added work and expense of the separate billing. In most instances the two bills are sent out at the same time. Some cities merely add an additional item to the water bill. One item is for water consumed and the other is for water disposed.

Some provision must be formulated in the case of delinquencies. The administration must have authority to enforce collections. A notice should be sent to the consumer when a bill becomes delinquent, with a statement as to the procedure which will follow if the bill is not paid. A penalty may be added to delinquent bills or a discount may be allowed for prompt payment. Unpaid bills are certified to the county auditor and become a lien upon the property. In some cities the water payment is not accepted without the payment of the sewer bill. Consequently when the water bill becomes delinquent the service is shut off.

The operation and maintenance of the sewage treatment plant must be in the hands of a good administrator. When the service is not large enough to warrant the employment of a supervisor it should be under the supervision of the city engineer or superintendent of the municipal utilities. The large investment in a sewage disposal plant is justified only when it is operated in the most efficient manner.

Sewer rental rates now in effect vary a great deal, depending largely on local conditions. Some rates based upon metered water consumption range from two cents to forty cents per thousand gallons. The average is approximately fourteen cents. Amounts range from ten to one hundred per cent of the water bill, with an average from forty to forty-five cents. Ready-to-serve fees range all the way from ten cents to one dollar per month with an average of about thirty cents.

Charges based upon flat rates vary just as much as those based upon metered water consumption. An average of some of the monthly charges in effect are as follows:

Private toilets	$ .20
Public toilets	1.50
Kitchen sinks	.20
Bathtubs	.10
Lavatories	.05
Laundry tubs	.05

An average of some of the flat connection charges per month are as follows:

Single family residences	60 to 75c
Apartments, per family	30 to 40c
Hotels, per room	20 to 25c
Rooming houses	20 to 25c
Plus 10c per person	

Damages from Stream Pollution

It is recognized that tidal waters are subject to different rules from ordinary streams in considering the question of pollution by sewage discharged therein. Although the authorities are not unanimous, it appears in some jurisdictions that statutory authority to discharge sewage into a tidal stream is a sufficient defense in an action for injunction or damages. But, the

South Dakota Supreme Court says, in refusing injunction and awarding damages to the plaintiff in an action to restrain a city from discharging sewage into a river running through plaintiff's farm and to recover damages caused by the pollution of the river, the South Dakota statute, in granting a right, on condemnation of private property for the construction and maintenance of a sewerage system, grants the right to discharge sewage into a stream on condition that the disposal shall not "create any foul or obnoxious odors in the air or along the stream." This, it holds, is a recognition that legislative sanction cannot justify the taking or damaging of private property without compensation. But the fact that a public interest is involved, that the health of a large number of people would be imperilled by restraining the continuous use of the sewerage system and such injury would greatly exceed the private or personal loss and inconvenience resulting therefrom, and that a fair opportunity should be given to the city to complete additions to its sewerage plant in course of erection, will control the court in framing its conclusions and judgment. (Parsons vs. City of Sioux Falls, 272 N.W. 288.)

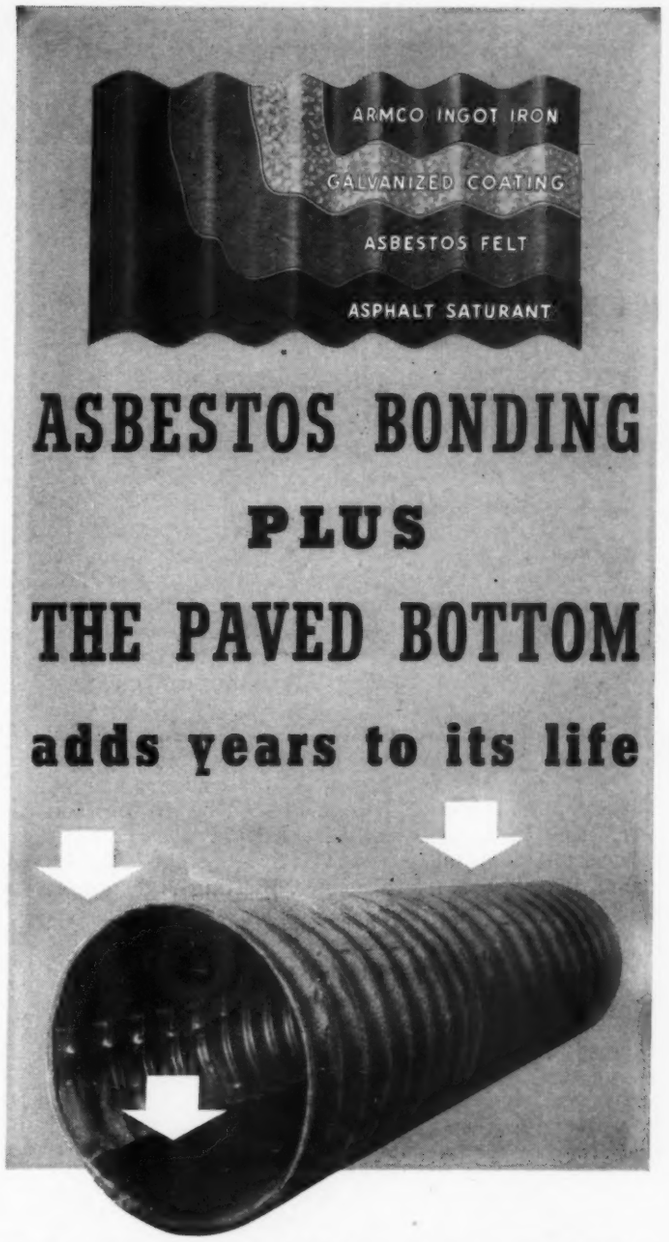
Treating Sewage Containing Pickling Wastes

At the Calumet sewage treatment works of the Chicago Sanitary District, an activated sludge plant designed to handle 136 mgd and treating an average of 65.4 mgd in 1937 (113.4 mgd maximum day), iron pickling liquor wastes in the sewage have presented a difficult problem in the operating of the aerating tanks. The ferrous sulphate in the wastes causes a deposit of ferric oxide in the upper pores of the diffuser plates and interferes seriously with the maintenance of efficient and uniform aeration. The use of a layer of coarse crushed limestone four to six inches deep over the diffuser plates as a temporary expedient has proved to be an effective method of lengthening the period between cleanings of the plates and thus maintaining fair conditions of aeration. The effectiveness of this expedient varied in different tanks. At best, it can only be considered as temporary until a final solution is found.

Contact with the industries producing these iron wastes has been maintained with a view toward preventing the discharge of such matter into the sewers and finding suitable methods of utilization or other disposal. As a result, a portion of the iron wastes now goes directly into the Calumet river or the Calumet-Sag Channel. The possibility of collecting these wastes and chlorinating them for use as a sludge conditioner in place of ferric chloride is now being investigated.

The effect of the absence of these wastes on the character of the Calumet sewage was evident from the improved operating conditions during periods of low production at the steel mills. During the strike in July the iron content of the return sludge dropped to 8 per cent (dry basis). Since October the rate of steel production in the Calumet area has been falling steadily and the percentage of volatile matter in the sludge has been increasing, the sludge settling index has improved and a thinner sludge mixture has resulted. Clogging of diffuser plates does not appear to be so acute although there is still considerable iron in the circulating sludge.

The ferrous sulphate has also caused some trouble in the operation of the vacuum filters, clogging the filter cloth and making it ineffective before it is worn out. Washing with an acid solution appears to be of some value but should be more thoroughly tested to discover the best method.



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Street Improvements in Homewood, Alabama

By S. E. RUTH
City Engineer, Homewood, Ala.

S. E. Ruth

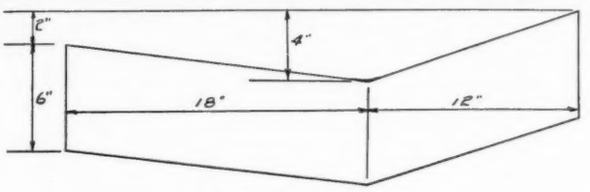
HOMEWOOD, Ala., is a young city and thus has growing pains no end—rather at all ends. Homes are built beyond improved streets and sanitary sewers, and a growing pain begins—so does my job of trying to alleviate it with a minimum cost to the property owners. Homewood is strictly a residential city of approximately 7,000 people. More homes are being built on "the mountain" than in any location close to the greater Birmingham district.

Homewood's proximity to Birmingham provides an ample labor supply as well as a close material source. By putting the two together we have been able to build much-needed street improvements, sanitary sewers, drainage projects, etc., at low cost. But due to the fact that the city's finances will not permit the issuance of street improvement bonds, the financing of these projects has been difficult.

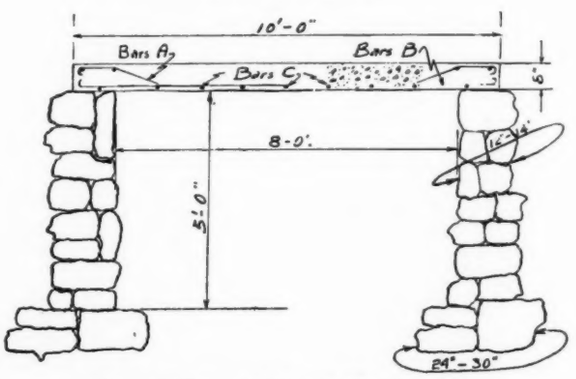
Most of the pavement has been double bituminous surface treatment according to the Alabama Highway Department specifications with a few minor changes. Chert for the base course is obtained by drilling and blasting in a conveniently located pit. The chert has such a high "metal" content that five- to eight-foot holes are drilled with a jackhammer. Blasting is done with Gelax No. 2 or Gelamite No. 2, without springing the holes. Compaction of the chert base is obtained by use of a home-made sprinkler, a ten-ton, three-wheel steam roller, and traffic.

Due to the high metal content of our chert, we get a mechanical lock of particals after compaction that is of more value than a large amount of clay binder. This is more particularly true where the chert is not to be used as a wearing surface. Where chert is to be used as a wearing surface, the proper amount of clay will tend to cut down raveling.

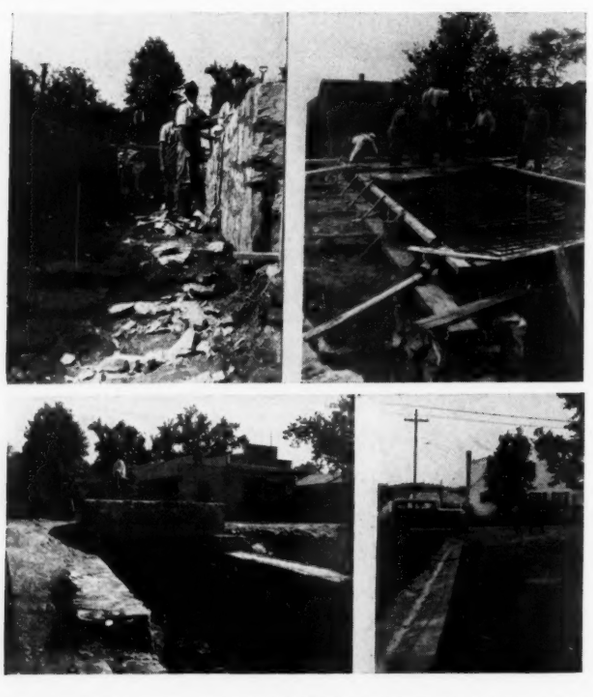
A 30-inch valley type gutter (see sketch) is built wherever the gradients and other conditions will permit. This eliminates the cost of turnouts for driveways, and since sidewalks are getting out of style the valley type blends nicely with a well-kept lawn. On through streets, standard curbs and gutters are built, with the needed turnouts for driveways and alleys.



Sketch of valley-type gutter



End elevation of 8 ft. by 5 ft. box culvert



Top—Building masonry wall for 8x4 ft. culvert 30 ft. long, and pouring roof of same. Bottom—Completed culvert. Right—A 30-in. valley-type gutter

One of the worst obstructions to some of our street improvements was the construction of culverts in large drainage ditches. This cost was kept to a minimum, in most cases, by constructing a culvert having a reinforced concrete slab with heavy ruble masonry walls. The rock for these culverts was quarried by the W.P.A., which meant considerable saving in material costs. One of these culverts was 1,380 feet long with a 5½ x 5½ foot opening. The construction of this culvert removed an unsightly and unsanitary ditch in the street of one of the nicer residential sections of the city. Paving is now in progress on this street and eventually it will be one of the most beautiful streets we have.

Like all other southern cities, Homewood has its negro quarters. The construction of improved streets in this section was out of the question from a financial standpoint. However, grading and draining of many of the streets in the negro quarters was accomplished by the use of W.P.A. labor and the aforementioned rock culverts. Many of these streets were impassable during the winter months and offered serious obstructions to fire lanes. The mud was eliminated by proper drainage.

grading and stabilizing of the riding surface with cinders. (We were fortunate enough to have a large supply of cinders in an old furnace site just outside the ciy limits.) As the results obtained were quite successful, a brief description of the method of applying these cinders might be of interest.

Procedure in Street Improvement

First, the necessary drainage was taken care of in the form of culverts, ditches or pipes of some kind. Second, the street was machined to a uniform grade. Third, cinders were applied and spread to a depth of about two inches over the entire surface. Fourth, the entire surface was then scarified lightly and machined back into a smooth surface. Fifth, the entire surface was then rolled with a ten-ton roller.

Some of these streets have stood up for as long as six to eight months without any additional machining or maintenance of any kind. I attribute a great deal of the success of the use of these cinders to the fact that they are many years old and thus an inert material. I have found that new cinders tend to work and crawl more than the old cinders.

During the past twelve months we have put down approximately 35,000 square yards of pavement, approximately 10,000 lineal feet of curb and gutter, approximately 10,000 linleal feet of graded streets, 5,000 lineal feet of flagstone sidewalk and several large drainage structures. The original project is still under way with a new $90,000 city-wide street improvement project approved and ready for operation.

When the street project was first started some difficulty was encountered in getting the property owners to contribute to the work. However, after a few streets had been improved, demands for this work began to come in from all over the city. Our procedure was very simple — when a group of property owners requested street improvements I would make them an estimate of the material cost and leave it up to them to pro-rate this cost among themselves, either by lineal foot or at so much per lot. When the property owners had turned the required amount of money over to the city clerk then I would stake the work and authorize the W.P.A. superintendent to begin construction.

Cost to Property Owners

The cost per 50-foot lot varied from $40 to $60 for curb and gutter and the double bituminous surface treatment. Of course, this method did not always work out one hundred per cent, as there were always one or more property owners in each block who could or would not pay his part. With the exception of one street, the work was always carried to completion in spite of the one or two holdouts.

James E. Summerville is superintendent on this work for the W.P.A. and the writer is in charge of the work for the City of Homewood.

Daytona Beach Removes Lime From Mains

Daytona Beach, Fla., obtains its water supply from wells. Prior to 1937 the hard water had deposited so much calcium carbonate in the mains as to greatly reduce their capacity. A softening plant now treats the well water, which has a carbonate hardness of 232 ppm and non-carbonate hardness of 42 ppm, sufficiently to cause it to take up about 125 lbs. per day of the calcium carbonate deposited in the mains. After this process has gone far enough it is proposed to stabilize the treated water to avoid both further deposits and formation of iron oxide tubercles.

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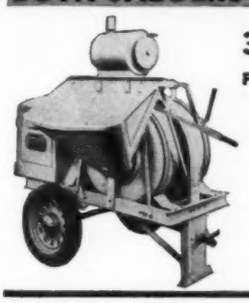

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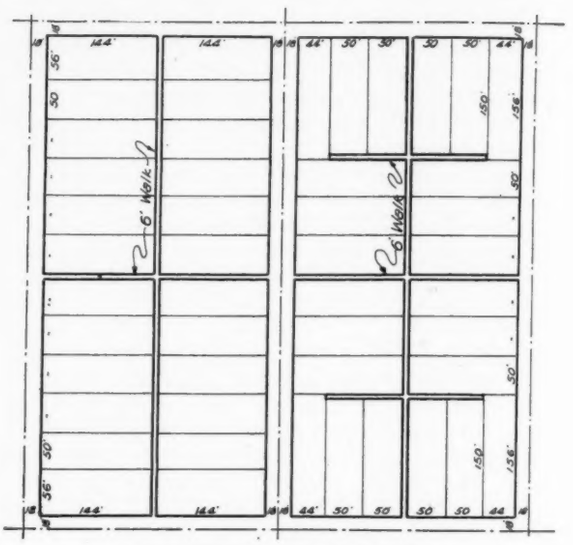
Promoting Pedestrian Safety by Better Street Layout

By D. V. PURINGTON, Assoc. M. Am. Soc. C. E.

THE writer lives in one of the most desirable neighborhoods in the city of Austin, Tex., but there is not a sidewalk in the entire area; the original subdivider apparently did not consider that mothers and children might live here who would desire exercise in fresh air and sunshine. In too many cases building lots are so small that, after the house and garage have been built, there is not room for even a decent game of catch. Even where there are sidewalks, parents fear to let their children walk to school because of danger from street traffic.

It therefore results that the only fresh air the children enjoy is that obtained while riding in automobiles, thus adding to the conjestion of street traffic. Which brings up another point. The increase in traffic introduces the problem of widening the roadway, and this generally proves difficult without excessive property damages or undesirable narrowing of sidewalk space.



Suggested plan for block layout

A Suggested Solution

In the early days many city blocks were laid out with service alleys, which have since been abandoned. It is these alleys which we believe will provide a possible solution of the safety problem for pedestrians, both young and old.

There is no particular reason why walks must be built around the perimeter of the blocks in such close proximity to the dangers from passing vehicles on the streets. The purpose of the walks is to provide a safe place for pedestrians to make their way from house to house or place to place, and in order to create this safety to a greater degree, it appears possible that walks might be constructed upon the longitudinal and transverse axes of the city blocks as the alleys once were built. Here they will be completely removed with any contact with the street except at crossings.

With the walks thus arranged on the interior of the blocks, the necessity for parkways and sidewalks at the curbs will be eliminated and additional room for the extra roadway widths will be less difficult to secure.

With this change in the arrangement of walks there is really no just reason for the present practice of building the garage at the greatest possible distance from the street. A driveway and turn-around take up entirely too much space on the small lots we have today and their cost is no small item in the lot improvement. If the new garage is built at the street line, it can be made attractive, safe and much more convenient than at the present customary location.

In areas which are already built, this plan will not require radical alteration other than the adaptation of the present alleys for walks, the demolition of the unsightly fences, and the provision at the street curbs of suitable garbage and trash containers which will not detract from the pleasing appearance of the street.

In new subdivisions, it may be preferable to face the houses toward the interior of the block and provide equally attractive entrances at both the front and back (with the yards divided into recreation areas and service areas for hanging clothes lines, etc.)—a plan which has been adopted in several communities, and in

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a number of new government-built projects with no apparent inconveniences.

Street Crossings — With pedestrian crossings at street intersection, the pedestrian has to observe four traffic lanes at four different angles to be sure he has a chance for a clear crossing, and the motorist must not only observe the traffic on the approaching streets but also look for pedestrians on all four corners of the intersection. But crossing in the center of the block, the pedestrian has to look in only two directions and the motorist has to observe only two sides of the street ahead.

When the city of tomorrow is built there will be a definite demand for tunnels or bridges to separate pedestrian and vehicular traffic. With the customary location of sidewalk this would require eight crossings for each block, but with sidewalks through the middle of the block only four would be necessary, giving a considerable reduction in cost; and where traffic is light, more of even these few could be omitted than would be safe with corner crossings.

In Business Areas—Where there is need for additional roadway width in business areas it is possible that the adoption of the interior sidewalk plan might be more economical than a program of street widening which involves the cutting off of building fronts. In applying the interior walk plan to the business area, it would not be practical to eliminate entirely the exterior walks, since these would still be necessary for the use of shoppers arriving in motor vehicles. But it is believed that the present width could be materially reduced if the show windows for window shoppers were moved to the rear of the present buildings to face the proposed interior walks. In this plan no street displays would be permitted at the street level, in order to eliminate the traffic hazard of the automobile driver who tries to drive and window shop at the same time.

As to loading and unloading of merchandise, this plan will not materially disrupt the service because the present alleys are not used consistently. Full enforcement of the ordinances which require loading and unloading to be done in hours of light traffic would still provide for this requirement of business service.

The ideas offered herein are mere suggestions for further enlargement. Studies of our city streets and block layouts will undoubtedly indicate other developments which will be possible to adapt our present system to meet the demands of modern traffic more effectively and safely.

New York City Inspects Hotel Plumbing to Eliminate Health Hazards

Bearing in mind the outbreak of amebic dysentery in two Chicago hotels in 1933, attributed after investigation to faulty plumbing, and in view of its invitation to the world to come to the city next year to visit its fair, New York City is taking steps to eliminate all hazards to the health of these visitors that might arise from defective plumbing—the water as delivered to the city mains is perfectly safe and palatable at all times. Of course, its own citizens and normal visitors also will benefit.

Attention is being paid to hotels, restaurants and other buildings serving the public. That such attention is needed, in addition to the routine supervision by the city's health department, is indicated by the fact that a sanitary survey of 1,200 buildings in the city recently conducted by that department found 511 plumbing cross-connections, some of a serious nature.

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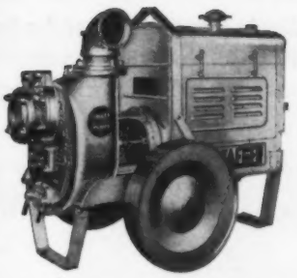

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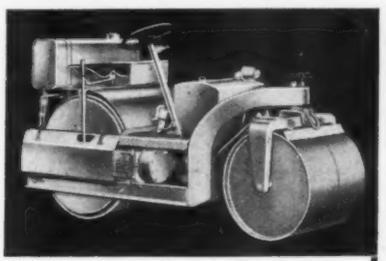

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Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

The Water Wheel

Clear Water Wells Omitted

In several (more than 8) small water works plants in Kentucky, the filter plant is not provided with a clear well, but the pump is connected direct to the filter discharge. This limits the pumping rate to the maximum safe filtering rate; which might be exceeded if a vacuum was formed in the filter discharge. With no clear well a washwater pump is out of the question, and a tank is used, filled from the distribution system. At Midway, Ky., this is mounted above the roof of the filter plant building.[F47]

Algae Treatment in Albany, N. Y., Reservoirs

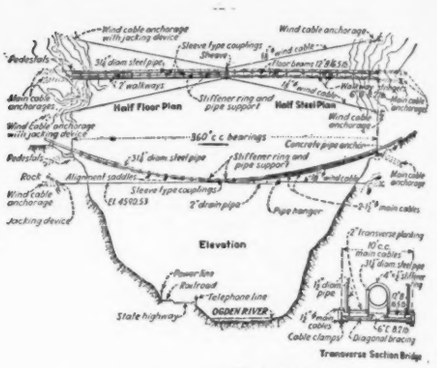
Attempt to control algae by continuously adding copper sulphate solution to the water as it left the reservoir for the filter plant 8 miles away killed the algae, but diatom cells remained intact and clogged the filters as much as when alive. The next method tried was to treat a part of the reservoir adjacent to the gate house with copper sulphate from a speed boat. A billion-gallon prism was fixed by ranges on shore and enough copper sulphate applied to treat this amount, which killed all the organisms and was generally effective for 60 days and is considered a success. The entire reservoir is treated in October with 0.12 ppm to discourage Synura. An experiment is about to be begun in continuous application of cupric chloramine to the tunnel carrying water from an upper impounding reservoir to the lower and larger one; this chemical, being stable and long enduring, should eventually build up an excess in all except perhaps remote bays. Blue-green algae developing on concrete side slopes of 4 distributing reservoirs form a mat there, and are controlled by shoveling onto the mats dry small crystals, which become mixed with the deposit, slowly dissolve and discourage further growth.[F42]

Meeting Peak Demands

The St. Louis County Water Co. has a maximum hourly consumption rate more than three times the average. Ten per cent of the peak demand is met by elevated storage in 5 standtowers and 2 elevated tanks, the cost of which, including the land occupied, was less than 3% of the cost of the plant and primary mains; additions to plant to supply that 10% would cost more than 10% additional investment. More elevated storage would be economical. During the hottest days, elevated storage will be conserved until the heavy afternoon draft begins. Another aid is "repump storage" — reservoirs at ground level from which water is pumped to the distribution system during periods of above-average demand; enables plant and transmission mains to operate at a nearly uniform rate, or to fill the reservoirs during hours of off-peak rates for electric power. Reducing peak consumption is effected by inducing certain large consumers (lawn sprinkling by golf and country clubs, truck gardeners, etc.) to confine such use to off-peak hours, by offering lower rates.[A99]

Suspension Bridge For Water Pipe

A 31-in. steel siphon was carried across a canyon on a suspension bridge of 360 ft. span by the Bureau of Reclamation near Ogden, Utah. It hangs 160 ft. above the river bed. Two 1½ in. cables on each side are anchored in tunnels carried 21 ft. into the vertical rock face and concreted. Distance between pairs of cables, 10 ft. Increase in sag of cables was 9″ due to dead load, 11″ additional for pipe filled with water. As elongation of cables due to water load is ⅛″ for each 20 ft. length of pipe, and wind produces lateral motion, flexible joints were necessary, and sleeve couplings with rubber gaskets were used. Each pipe is supported midway between couplings, with a saddle near each coupling but clearing the pipe by ¼″ to preserve alignment. Wind cables 1⅛″ diameter extend from center of bridge to canyon walls, stressed to 69,000 lb. by hydraulic jacks (which load was permanently transferred to anchorages by tightening nuts), this being the calculated stress for a wind load of 50 lb. per sq. ft.[E35]



Engineering News-Record

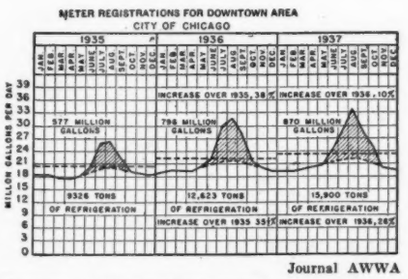
Pipe supported on cable bridge

Air Conditioning In Chicago

Demands for water for air conditioning in Chicago are increasing. The tons of refrigeration have increased about 25% each year, from 17,500 tons in 1932 to 49,000 in 1937, of which a little over a third has been each year in the downtown area. In 1937 about 30% of the tonnage was used by theatres, 25% by office buildings, 12½% by stores, 9% by restaurants, 6% by hotels, with less by manufacturing, clubs, residences and others. It is necessary to study air-conditioning demands for water by districts, as in high-class office and store areas severe problems of water supply and sewer capacity may develop, though these may be adequate in the city as a whole. During the maximum demand hour in August, 1937, in the "loop district," the demand for water for air-conditioning equipment was approximately 31% of the water required for all purposes in the area.[A100]

Water Softening With Carbonaceous Zeolites

Carbonaceous zeolite is manufactured from a carbonaceous material such as coal by treatment with a chemical such as sulfuric acid or sulfur trioxide, giving a hard, granular product with negligible silica content. Regenerated with sodium chloride it operates as a sodium zeolite by base exchange. If regenerated with acid it forms a hydrogen zeolite, and the hydrogen ion is exchangeable for the cations Ca, Mg or Na; called "cation exchange" rather than base exchange. They are applicable as base exchangers for softening waters of low pH value or low in SiO_2, or high in iron; where space is limited (flow rates of 6 to 8 gpm per sq. ft. of softener area are practicable); or after silica removal. As hydrogen exchangers, they remove sodium bicarbonate,



Journal AWWA

Curves of Water Consumption in Chicago

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All pipe and fittings joints shall be equipped with factory made lead joints.

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or calcium and magnesium bicarbonate, converting them to carbonic acid removable by a cold degasifier, thus removing the bicarbonates completely without forming any sludge. The hydrogen zeolite effluent can be used for recarbonation of lime-treated water; by proportioning a mixture of hydrogen zeolite effluent and sodium zeolite effluent, a constant alkalinity can be maintained. (As disadvantages, A. S. Behrman named the danger of handling concentrated sulfuric acid, and of some acid in the effluent.) Two of these zeolites are on the market, "Zeo-Karb" and "Catex."A105

Bibliography of Waterworks Literature
The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Ass'n*
June

96. The Human Element in Meeting Emergencies. By H. W. Niemeyer. Pp. 855-862.
97. Water Company Field Representatives. By G. O. Darnell et al. Pp. 864-874.
98. Increases in Water Demand and Their Causes. By O. C. Holleran. Pp. 875-880.
99. Meeting Demands Created by Air-Conditioning: Round table discussion. Pp. 881-891.
100. Air Conditioning in the City of Chicago. By L. D. Gayton. Pp. 892-897.
101. Accounting in Small Water Plants. By F. R. Mills. Pp. 898-911.
102. Business Procedure in the Water Sales Division. By T. M. Erwin. Pp. 913-929.
103. Meter Maintenance. By J. A. Mitchell. Pp. 930-939.
104. Up-to-Date Methods of Meter Testing. By J. L. Ford and R. V. Ford. Pp. 940-946.
105. *t.* Applications of Carbonaceous Zeolites to Water Softening. By S. B. Applebaum. Pp. 947-978.
106. *t.* A Modified Lactose Broth for Use in the Presumptive Test. By P. B. Cowles. Pp. 979-980.
107. Meter Specifications Today and Tomorrow: Round table discussion. Pp. 981-992.

D *The Surveyor*
June 24

24. *p.* Protection of Underground Sources of Water Supply. By E. Morton. P. 858.
25. *p.* Submerged Outlet Valves at Burrator Reservoir. By A. Atkinson. P. 859.

July 1

26. *p.* Water Wastage: Causes, Detection and Prevention. By J. A. Rodwell. Pp. 5-7.

July 15

27. *p.* Safeguarding the Purity of Public Water Supplies. By D. H. Thomson. Pp. 65-66.

E *Engineering News-Record*

June 30

33. New Water Supply for Salt Lake City. Pp. 899-900.

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34. Double Cone Precipitators To Be Employed at Minneapolis. Pp. 49-50.

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35. Suspension Bridge for Water Pipe. By R. Sailer. Pp. 75-77.

F *Water Works Engineering*

June 22

42. Five Years Operation of Albany, N. Y., Water Supply. By G. E. Willcomb. Pp. 848-853.
43. Special Rates for Garden Sprinkling. Discussion by A. W. W. A. Pp. 854-856.
44. Sand Expansion Tests at Montreal During Filter Washing. By F. H. Field. Pp. 857-858, 878.

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45. Maintenance and Repair Methods at Buffalo, N. Y. By N. N. Wolpert. Pp. 911-915.
46. *p.* Relative Reliability of Electricity, Diesel and Steam. Symposium. Pp. 918-919.

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47. Developing Small Town Supplies. By H. K. Bell. Pp. 968-972.
48. *p.* Maintaining a Distribution System in Northern New England. By J. R. Sweeney. Pp. 973-974.
49. Fluoride Reduction Plant at Bloomdale, O. By C. S. Finkbeiner. Pp. 990, 993.
50. New Well Drilling Practice at Savannah, Ga. By R. R. Schweitzer. Pp. 994, 997.

G *Water Works & Sewerage*

July

25. Water Works Improvements at Pittsburg, Kans. By W. J. Lapworth and T. D. Samuel. Pp. 677-680.
26. New Method of Weed Control in Reservoirs ("Cloroben"). By H. Seydel. Pp. 688-690.
27. Bacterial Aftergrowths in Distribution Systems. By J. R. Baylis. Pp. 720-722.

J *American City*

July

15. Water Works Underground Survey by Lima, O. By E. E. Smith and W. P. Snook. Pp. 35-38.

L *Civil Engineering*

July

2. Ground Water Supplies in Florida. By V. T. Stringfield. Pp. 457-458.
3. Large Delivery Lines for the Colorado River Aqueduct System. By J. Hinds. Pp. 469-472.

M *Canadian Engineer*

July 5

12. Activated Carbon Application for Reservoirs. By E. A. Sigworth. Pp. 6-8.

P *Public Works*

July

31. Filtration vs. Softening at North Chicago. By L. W. Fennell. Pp. 17-18.
32. Automatic Pump Control at Caledonia. By A. Houge. P. 18.
33. *n.* Cost of Repairing Broken Hydrants. P. 22.
34. Water Works Development in Venezuela. By H. C. Plummer. Pp. 25-26.
35. Building an 84 MGD. Industrial Water Supply System. By S. C. Watkins. Pp. 28-29.

Protecting a Power Shovel When Blasting

At the O'Shaughnessy Dam, in California, a wooden cover was built to protect the power shovel from damage when blasting. The use of this cover permitted the work to proceed with a minimum of delay. A stout wooden cover was built to fit over the entire shovel, except the boom and bucket. Just before blasting, this was raised by a cableway and set over the shovel. As soon as the blast was fired, the cableway picked up the cover and the shovel proceeded with its work.

Responsibility of Subcontractor

A subcontractor's contract for excavation and backfill expressly excluded any shoring or underpinning. The Pennsylvania Supreme Court held, in an action against the subcontractor for injury to an employee of another contractor by the cave-in of a wall (Walker v. McNichol Paving and Construction Co., 189 Atl. 673), that any duty of the subcontractor, as respected such injury, ended when it transferred control and possession of the wall to the general contractor. The duty of shoring then rested on the general contractor. So long as the general contractor remained in control defendant could not interfere. The accident, which did not occur until eight days after transference of control, was the result of inadequate shoring.

Injunction of Flooding of City Streets

In an action by a city to enjoin the flooding of one of its streets with irrigation water, the defendant, a farmer, contended that the flooding was caused by obstructions in a drainpipe which it was the city's duty to keep in repair; and he sought to require the city to provide proper drainage. The Idaho Supreme Court (City of Fayette v. Jacobsen, 66 P. (2d) 1013) held that the burden was on the farmer to prove that the flooding was caused by a defect in the drainpipe and also that it was the city's duty to maintain it in proper repair so as to carry away waste irrigation water from her land.

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A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

The Digestion Tank

Designing Pump Suction Wells

IN AN automatically operating pumping station, where a number of pumps cut into operation in succession as the sewage rises, the suction well should be so designed that starts will not occur more than 15 times an hour. The floats are usually set about 6″ apart vertically so that wave action will not cause two pumps to start at once; but in large stations a smaller factor of safety may be used and the sewage level may rise so fast as to cut in a second pump before the first has picked up its maximum speed. This requires about 20 seconds for pumps under 50 hp and 40 seconds for up to 150 hp; and the capacity of the suction well between the cut-in levels of any two pumps must be equal to the amount of sewage delivered by the pump that first cuts in during the time required for that pump to attain maximum speed. But pumps stop almost instantaneously when cut out, so cut-out levels can always be placed at 6″ intervals. Suction wells are best made long and narrow to produce natural scour of sewage through them to prevent deposits, with suction of lowest-level pump in a sump.[D43]

Trenches Sheeted With Plywood Panels

IN SEWER construction at Chicago Heights, Ill., including trenches 14 to 21 ft. deep for 21″ to 36″ sewer, plywood of Douglas fir, 4 x 8 ft. concrete form grade, ¾″ thick, was used for sheeting, with plywood cover plates over the end joints, screw trench jacks bearing against timber blocks on these plates. The saving over ordinary sheeting was 50% for labor and 80% for material. After repeated reuse 65% of the plywood was salvaged, the amount purchased averaging only 2 sq. ft. per lin. ft. of sewer. Trench widths were 6″ to 12″ less than with plank sheeting, rangers, etc., and excavation 15 to 20% less than estimated quantities. Excavation largely through heavy clay, with wet sand and water in numerous places when trench was more than 12 ft. deep.[E19]

Streets Drained by Wells in Miami

THE ground surface of Miami, Fla., averages 8 ft. elevation above mean low tide, much of it only 3½ to 4 ft., with normal tide range of 36 in. Hence drainage of streets by gravity sewers is impracticable for much of the city. For the worst areas the water is drawn off through 146 drainage wells 65 to 300 ft. deep, 8 to 18 in. diameter, drilled to salt-water-bearing materials. Rain is removed by these in a few hours after falling. One well often serves several blocks in each direction, inverted siphons being built at street intersections. A maintenance force removes the dirt that accumulates by lowering to the bottom an air point at the end of a hose and blowing a large volume of air at high pressure until the dirt has been thoroughly removed and deposited outside the well. Other devices are trenches dug into the porous rock and covered with slabs of concrete or other material, or pits dug into the rock and filled with boulders; but silt gradually fills the voids of these.[L4]

Effects of Activated Carbon in Sewage Treatment

OF 12 plants using activated carbon in sewage treatment a number have found it reduces odors, others that it accelerates and increases gas production, aids in eliminating scum nuisance and removing grease, 3 that it improves digestion in unheated digestion tanks; drainability on sand beds, filterability on mechanical filters, sedimentation in primary tanks and performance of humus tanks are reported improved by it. Experiments with "Nuchar" at the Cleveland southerly sewage plant were made to learn how it could be used to advantage there. Results were inconsistent. A dose of 2 ppm slightly aided settling, greater doses impeded it. Odor was greatly reduced by 2 ppm, and removal was practically complete with 8 ppm. They found no appreciable effect on pH or gas production, but some others have; lack of agreements "points, not to a lack of effect of carbon on sewage processes, but rather to an incomplete and inaccurate understanding of its role in these processes." There definitely appears to be an optimum dosage, probably below 4 ppm.[C51]

Treatment of Canning Wastes

AT De Kalb, Ill., the canning company operated 59 days in 1937 canning over 12 million cans of corn, besides peas and lima beans, the wastes going to the sewage plant (sedimentation, sprinkling filter, sludge digestion). To prevent uncontrollable septic conditions in the primary settling tank, plant effluent was pumped to the raw sewage conduit, 60.81 million gallons during the 57 days, or a little more than the sewage flow.[C63]

Continuous Operation of Sludge Collecting Mechanism

AT Ann Arbor, Mich., two primary settling tanks, 78 x 16 ft. by 10 ft. 6 in. average water depth, contain straight-line sludge collecting mechanisms. During a 4-month period these averaged 43% reduction of suspended solids, operated at 1500 gpd per sq.ft. of tank area. Sludge pumped to digesters averaged 4.9% solids. "The sludge collecting mechanism was operated continuously for a period of one month to note the effect on the solids concentration. No measurable difference was noted in favor of either continuous or part-time operation of the mechanism.[C59]

Handling Supernatant Liquor

JACKSON, Mich., mixes supernatant with primary influent, using two-stage digestion. Draws supernatant from primary digester to secondary for two days and sludge on the third. When secondary is full, supernatant is drawn from it gradually, samples being taken periodically, until it begins to get heavy or until floating cover descends almost to the stops. Solids in supernatant varied from 0.07% to 0.30%. Supernatant does not upset primary tanks at all; B.O.D. and total nitrogen of primary effluent is slightly higher when supernatant is drawn than with sewage alone. Supernatant causes no ill effects in secondary treatment (activated sludge) and little difference in final plant effluent, the B.O.D. of which varies from 2.7 to 3.0 ppm.; gold fish live in the final clarifiers.[C58]

Sludge Drying Bed Capacities

SLUDGE on sand beds dries partly by drainage, partly by evaporation. The drainage rate decreases rapidly as the pores of the sand fill up. Little takes place after 6 to 18 hrs. The higher the initial water content of the sludge the larger the percentage of water removed by draining. The less the depth of sand in the bed the better the drainage; 2″ of sand on a screen dried the same depth of sludge in half the time neces-

sary on ordinary beds. At three Long Island plants using covered beds, these were in use less than 50% of the time, and "If the sludge is removed from the beds when the moisture content is near 75% it would be possible to dry sludge satisfactorily at these plants with an area of not over 0.25 sq.ft. of glass-covered beds per capita." [C57]

Power Used in Plant Operation

At the Jackson, Mich., activated sludge plant the average daily flow is 6.4 mgd, about half the plant's capacity. The power used averages 693 kwh per million gallons of sewage treated, of which 55 kwh is for pumping raw and excess sludge, lighting and other features of primary treatment, and 638 kwh for secondary treatment; the latter including 439 by the blower, 127 by the paddle wheel aerators, 62 by the settled sewage pumps and 10 by the return sludge pump. The blower power is based on using 0.8 cu. ft. of air per m.g.; at 0.6 cu.ft. it is 375 kwh. Instead of using the unit of power per day or per mg of sewage, Mr. Jackson considers it better to use the work done in the form of pounds of B.O.D. or of suspended solids removed. The pounds of B.O.D. removed per kwh used by blowers and agitation varied from 0.71 to 2.31, monthly averages.[C58]

Dissolved Oxygen Depletion in Illinois River

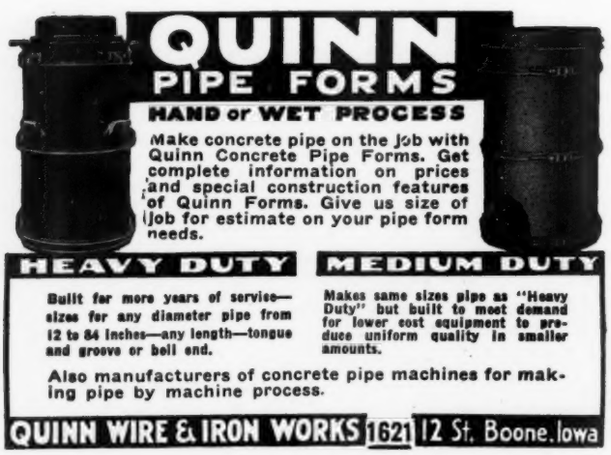
In the stretch of about 70 miles of the Illinois river between Peoria and Beardstown, during July and August the total aeration capacity was 526,000 lb. of oxygen per day and the total B.O.D. in the same stretch was 667,000 lb., of which sludge deposits were responsible or 263,000 lb. "This high value shows the cumulative effect of these deposits in that their greatest demand is exerted at time of critically low, summer river flows." The pollution is due chiefly to human wastes of 130,000 plus industrial wastes equivalent to a population of more than 1,000,000; treatment of human sewage reducing this to a population equivalent of about 12,000 before discharge.[C62]

Order of Adding Chemicals in Coagulation

Experiments in use of ferric chloride and alum as coagulents, and lime and sulphuric acid as adjusting chemical, to learn which should be added first, seemed to indicate that so-called adjusting chemicals are themselves coagulents, that total coagulation with their use is perhaps the sum of that produced by both minus that caused by any interference between them. In some plants, addition of an acid or lime seems necessary only during certain hours of the day (probably due to laundry or other wastes). When lime and ferric iron were used, adding lime first gave best results except with septic sewage and low coagulent dosage. Using acid and ferric iron, coagulent before acid gave far better results. Results using alum were similar but "alum clarification appeared to be consistent for different types of sewages," alum producing results more predictable than ferric iron, probably because it "is less affected by the presence of reducing substances in the sewage." When alum or ferric iron is used alone, the alum floc is often more light and fragile. Clarification when acid was added after alum was more noticeable as alum dosage increased.[C52]

Operating a Digestion Tank

At Rockville Centre, N. Y., eight digestion tanks, total capacity 63,600 cu.ft. giving more than 3 cu.ft. per capita, treat combined primary and activated sludge. Concentrated sludges of both kinds are first mixed in a separate tank and allowed to stand, which, in Mr. Andersen's opinion, "is of advantage not only in concentrating solids but also in adjusting the organisms so that the aerobic organisms are reduced and anaerobic action started." This reduces the volume of sludge by about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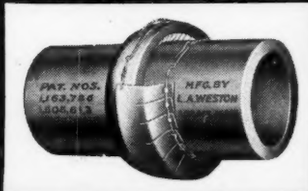

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70%, therefore the amount of supernatant in the same proportion and also the amount of heat required to maintain the desired temperature. Hydrated lime is added to the sludge as it is applied to the tank, 300 to 400 lb. to the 1600 cu. ft. of 2.96% sludge which is applied each day. Also during cold weather each tank is limed and turned over once in 8 weeks. Sludge is withdrawn twice a month, leaving 9 ft. of sludge in the tank. The supernatant, in volume about 2½% of the sewage, has a B.O.D. ranging from 200 to 1200 ppm and suspended solids content averaging 850 ppm; this is returned to the sewage.[C56]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

C *Sewage Works Journal*

May

51. *t.* Effects of Activated Carbon in the Digestion of Fresh Solids. By G. E. Flower, C. B. Budd and C. Hauck. Pp. 441-449.
52. *t.* Chemical Coagulation of Sewage. By W. Rudolfs and H. W. Gehm. Pp. 450-457.
53. *t.* Studies on the Clarification Stage of the Activated Sludge Process. By R. S. Ingols. Pp. 458-464.
54. *t.* Influence of Oxygen Concentration on B.O.D. By R. Pomeroy. Pp. 465-481.
55. Sewer Rental Laws in Michigan. By G. H. Sandenburgh. Pp. 482-493.
56. Sludge Digestion and Inspection of Tanks at Rockville Center, N. Y. By C. G. Andersen. Pp. 494-502.
57. Sludge Drying on Open and Covered Drying Beds. By L. V. Carpenter. Pp. 503-512.
58. Jackson, Mich., Sewage Plant Operation. By R. B. Jackson and R. A. Greene. Pp. 513-522.
59. Experiences and Results of First Year of Operation of the Ann Arbor Sewage Treatment Plant. By H. P. Dodge. Pp. 523-533.
60. Textile Waste Disposal: An Orderly Approach to the Problem. By L. L. Hedgepeth and C. B. Griffin, Jr. Pp. 534-538.
61. *t.* Some Factors Affecting the Aerobic Decomposition of Sewage Sludge Deposits. By H. G. Baity. Pp. 539-568.
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THE STERLING DIESEL ENGINE

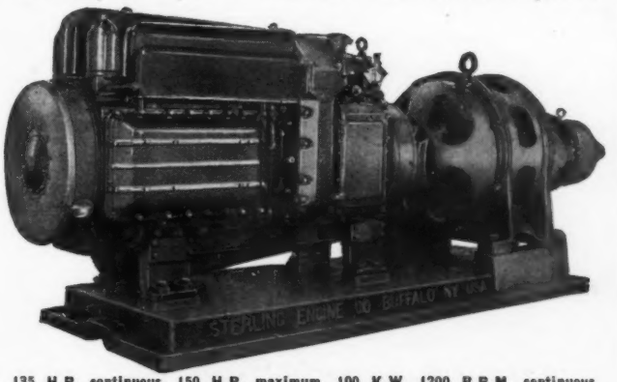
achieves natural turbulence without using pre-combustion chambers or cylinder heads or valves

Best atomization of fuel is secured with high efficiency. Ample air intake and exhaust ports scavenge the cylinder completely. Pistons act also as valves, eliminating many parts.

Sterling High Duty

Sterling — The Engine of Refinement

Internal Combustion Engines



135 H.P. continuous, 150 H.P. maximum, 100 K.W. 1200 R.P.M. continuous service Sterling Diesel Generator Set. (Michell Patents)

GAS — GASOLINE — DIESEL — ENGINES

If you contemplate a diesel installation, investigate the possibilities of direct connecting the Sterling engines to pump or generator. Save tremendously in first cost and in fixed charges.

STERLING ENGINE COMPANY

Home Office and Plant
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Keeping Up With New Equipment

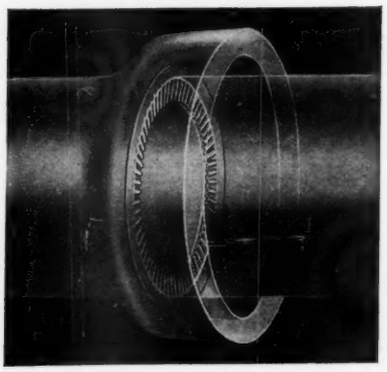
Jaeger "Speedster" Mixer

Latest addition to The Jaeger Machine Company's line of end discharge mixers is this 3½S "Speedster," a tilting type which features the same type of air-cooled engine as is used on Jaeger pumps. The 2½ H. P. plant is housed between

Jaeger 3½S Mixer

drum and axle, making a very compact mixing unit. In addition to the saving of hundreds of pounds of weight, the end discharge design eliminates the need for turning or backing barrows when discharging and is particularly convenient for backing up to foundations, windows or chuting.

The machine is mounted on spring shock absorbers. Timken bearings and pneumatic tires, with detachable towing pole for fast trailing and easy maneuvering. Standard Jaeger construction is used throughout, including patented "V" spot drum with cone of Man-Ten steel, mounted on sealed Timken bearings. A new bulletin describing this and other latest type end discharge mixers may be obtained from The Jaeger Machine Company, Columbus, Ohio.



A-B-C Stop-Root Ring shown in place in joint

Guaranteeing Root-Free Sewers

The manufacturers of the "stop-root" rings for making sewer joints go a lot farther than just stating that there will be no trouble from roots entering the sewer lines. They issue a guarantee that the clay or concrete sewer, when laid properly with these rings, will "for a period of ten years be free from trouble caused by roots entering at any juncture of socket and spigot." This guarantee covers the reasonable cost of clearing a root-clogged sewer and any necessary actual repairs to the sewer. We call that a pretty fair proposition.

The illustration herewith shows the simplicity of the ring and how it is installed. It is an open-end flat ring of copper which is placed in the bell; the joint is then formed as usual, using a cement mortar or bituminous compound. For further information, an instructive and interesting folder, and a copy of the guarantee, write A-B-C Manufacturing Co., 227 South Fourth St., Quincy, Illinois.

Streamlining the Stone Crusher

Some time ago the Universal Crusher Co., Cedar Rapids, Ia., introduced a 10x16 streamlined jaw crusher. They say that these new models took so well that they now announce a larger model, with a 24x36 feed opening. The illustra-

Universal Streamlined Crusher

tion herewith shows what a smooth job it is. The usual reinforcing ribs are on the inside, and there is a 20% reduction in weight. There are many interesting new features in construction. Full information from the manufacturers.

Good Roads "55" Grader

The Good Roads "55" grader is designed to meet the need for a maintainer-grader equipped for one-man operation, with full power hydraulic control, for use with wheel and track-type tractors of medium sizes. It is strong enough and flexible enough for ditching work and other construction jobs. For this purpose the grader is provided with a second set of power hydraulic controls and an operator's platform. From this platform the operator has an unobstructed view of the blade, and an instantaneous control over raising, lowering and sideshifting the blade, and sideshifting the grader on the rear axle.

An entirely new feature of the "55" is the unique design of the circle. Two large diameter concentric circular steel plates are flanged and fitted one inside the other. The larger, outside plate is welded to the drawbar; the smaller turns easily inside the larger, yet is closely fitted and firmly held to prevent chattering. The moldboard is attached to heavy steel plates welded to the inner circle. In tests and under various working conditions this construction proves to be exceptionally strong, does away with chatter, and provides easy adjustment of blade angle.

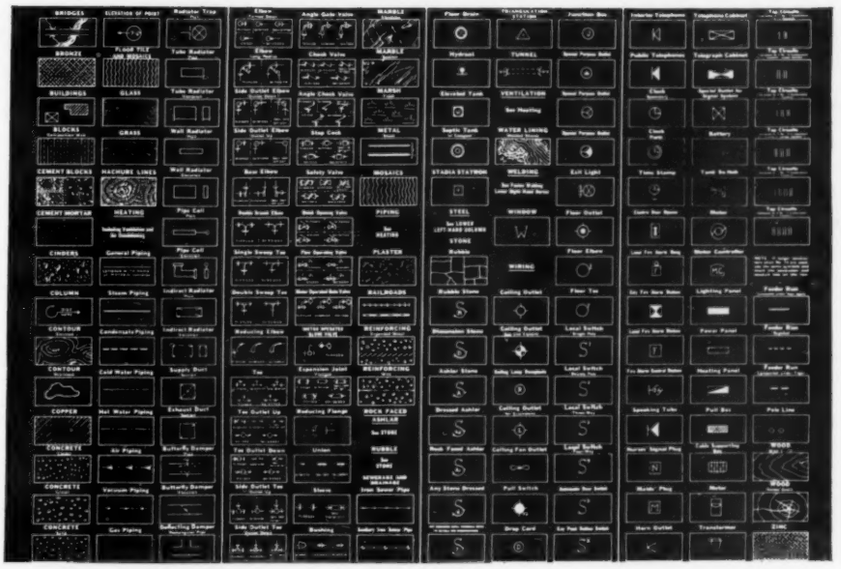
The new Good Roads "55" Maintainer-Grader

Tuthill Highway Divider

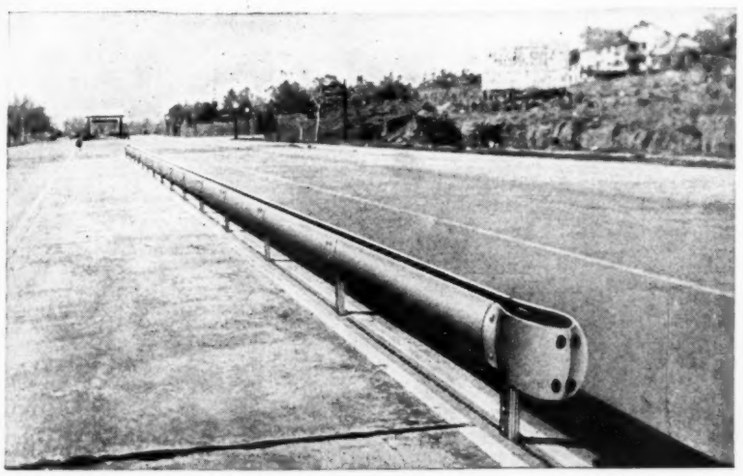
The Tuthill Spring Co., Chicago, Ill., manufacturers of highway guard rails, announces a "road center divider" to be used primarily on the rapidly increasing number of four and six lane highways that have no center separation other than the conventional white lines. Police records show that a large percentage of accidents occur because of cars weaving in and out of line and crossing over to the opposite side of the road. This new road center divider not only makes it impossible for cars to cross the center of the road, but due to its spring steel construction actually deflects any vehicle that may strike it, without injury to the occupants, the guard rail, or the vehicle itself.

According to the manufacturer, this physical barrier actually takes up less space than the double white line generally used as a center marker. One of the most outstanding features claimed for this steel road center divider is the simplicity of installation and maintenance under all conditions.

Numerous highway safety campaigns include the establishing of a "neutral center-zone" for traffic protection, and it is for this reason that the Tuthill Company feels confident that their new divider will be received with enthusiasm by both highway departments and the motoring public.



Architectural and engineering symbols are shown in this chart. Original is 26 x 35 ins., and contains 249 symbols—count them. Sent free to engineers, architects and users of drafting room supplies. Frederick Post Co., Chicago, Ill.



Tuthill divider for 4- and 6-lane roads

New "Caterpillar" Diesel Auto Patrol

A heavy-duty, self propelled road grader, the Diesel No. 12 Auto Patrol, has been announced by Caterpillar Tractor Co. It is designed for road building as well as road maintenance work, and has a range of useful blade positions surpassing even the modern blade grader. In addition to high or low bank cutting positions, the blade can be turned completely around on the full revolving circle. With ample clearance both front and rear, the blade is thus positioned for working in reverse gear. This feature will be valuable for sub-grade work, shaping bad spots, working short stretches or where turning is difficult.

With the blade mounted in the center position on the blade beams, this machine permits a correct ditching position on either side, with the toe of the 12-foot blade behind the front ditch wheel.

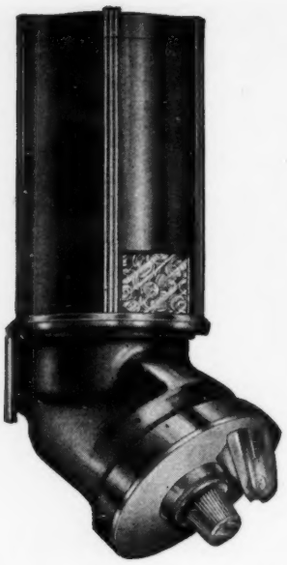
A six-cylinder "Caterpillar" Diesel Engine delivers 66 brake horsepower. A gasoline starting engine is used. The transmission provides six forward speeds and two reverse, with a low speed of 1.8 mph and a high of 15.2.

Speeder ¾-Yard Shovel

Speeder Machinery Corporation, Cedar Rapids, Iowa, announces a new ¾-yard convertible model "LS-80" shovel. This 19-ton machine has electric welded, alloy-steel lower base, positive steering, and traction lock controlled from operator's seat.

The "LS-80" has two speeds in traction and either 20" or 24" lug-driven tracks or "Caterpillar" tractor tracks are available. All upper machinery is behind the center pin which cares for horizontal stresses. There are two independently mounted power drums and a positive self-locking, worm-geared, two-speed boom hoist.

Caterpillar diesel patrol maintainer



Sodium chloride tablet dispenser. Salt is necessary in hot weather to prevent heat sickness of workers who perspire freely. Industrial Products Co., Philadelphia, Pa.

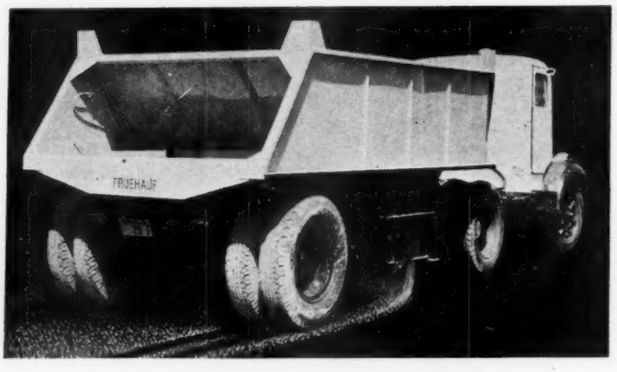
Stopping Piston Ring Leakage In Engines and Compressors

A new type of piston ring is now available for all sizes of air compressors, gas engines and oil engines. According to the Wilkening Mfg. Co., Philadelphia, Pa., which makes these, they will seal the engine bore, seal the ring groove, hold high compression, eliminate "blow-by" and stop dilution. This is accomplished by a matched lap; a black oxide coating is available on the ring, or these can be furnished with a "silcoat" finish which gives quicker seating of the ring. If your compressors or engines aren't doing so well, write the manufacturer for more dope. Full information will be sent on request.

New 8-Yard Fruehauf Gravel Spreader

A new gravel spreader has been introduced by Fruehauf Trailer Company, Detroit, Mich. This unit spreads not only gravel but cinders, sand, crushed rock, etc. It has an 8-cubic yard body, is strongly reinforced, yet weighs only 5200 pounds fully equipped.

This spreader allows a flow of material adjustable from ½" to 7½"—and the specially-designed discharge gate enables the flow to be shut off instantly, without seepage. This discharge gate can be operated either by hand, vacuum, or air—and can be cab-controlled to permit one man operation, at a saving in operating cost. Spread is even and continuous.



New 8-yd. Fruehauf gravel spreader

⅜-Yard Hanson Shovel

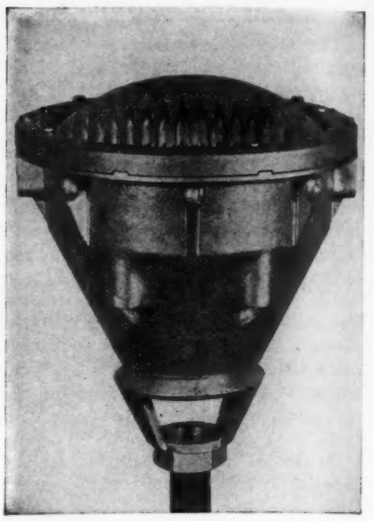
Hanson Excavator Works, Tiffin, Ohio, have brought out a new ⅜-yd. shovel, the Comet. This is convertible into a drag-line, trench hoe, clamshell, crane or pile driver. It can be mounted on crawlers or on a truck. All clutches and brakes are operated by Lockheed Hanson hydraulic controls. Fuller information in booklet sent on request.

Traffic Line Guards

This road maintenance business is dangerous work, and all the protection available too often isn't enough. These guards consist of a steel base section, a flat spring for holding the flag staff in position, a steel flag staff, a slip collar for holding the flag at half-mast, if desired, a red cloth flag, and a removable staff cap to make renewal of the flag easy. Because they span the line, only half as many of these guards are required. They nest easily and closely. The General Road Equipment Co., Hanna Bldg., Cleveland, Ohio, will send one of these guards to any responsible highway or street official who writes on his letterhead to them, so that he can look the guard over and see how it is built.

New Highway Concrete Vibrator

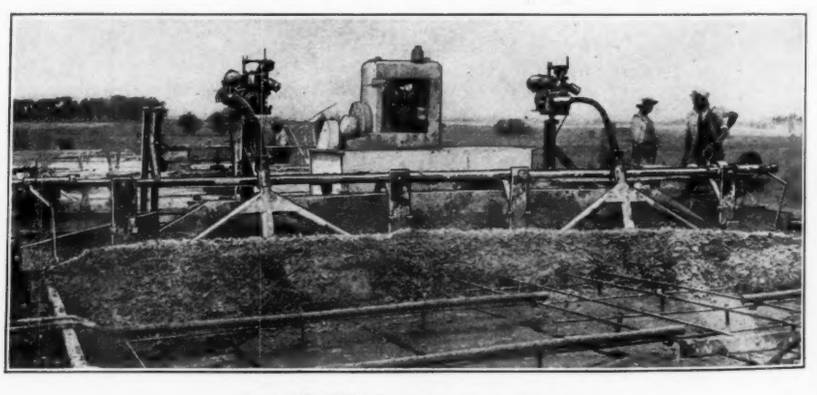
The Mall Tool Company, Chicago, Illinois, has introduced a new highway concrete vibrator which can be attached to any make of pavement finishing machine. A single unit can be furnished to vibrate pavements up to 12 feet in width and a double unit for pavements up to 20 feet in width; adjustable for vibrating crowned and straight pavements.



Westinghouse underwater floodlights are used in pools, fountains, waterfalls, etc. Colored lenses are available to give any desired effect. Further data on request.

The power is developed by two 3 H.P. gas engines which are equipped with automatic clutches and high speed countershafts. The power developed by these gas engines is transmitted to the concrete paving vibrator tool by means of heavy duty flexible shafting.

The most important features of this machine are as follows: The highway slab is surface finished with one pass of the equipment; the two vibratory elements furnish double the energy to compact the concrete; vibration is placed evenly along the forms without pushing concrete over the edges, and gives complete vibration to the subsoil or base; vibrating tubes are lifted vertically out of the concrete, permitting thorough vibration near the expansion joints; the vibrating tube, because of its small diameter, is readily immersed aud pushed through the concrete which rolls over the vibrating tube for the entire width; it does not interfere with the work done by the finishing screed; the unit reduces finishing time with the least initial investment and the lowest maintenance cost; the vibration effort in concrete is applied in all directions due to the slant of transverse vibrators, and there is even vibration effort over the entire width of the highway pavement.



New "Mail" highway paving vibrator

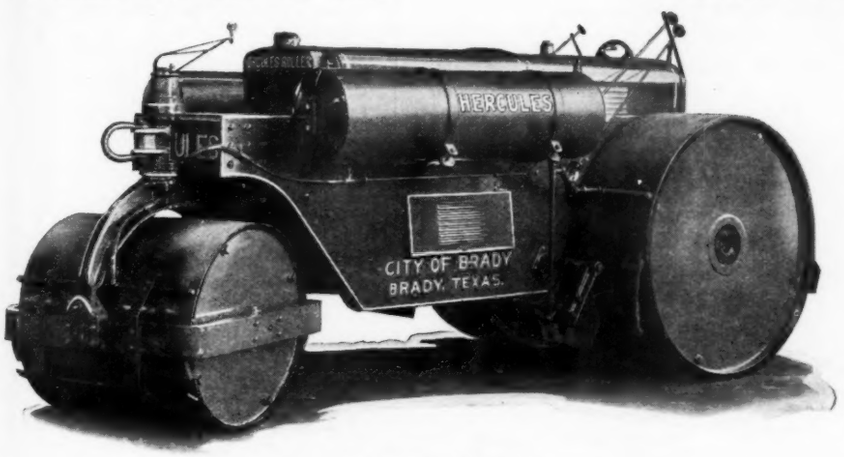
Hercules Variable Weight Rollers

The Hercules Company of Marion, Ohio, announce an addition to their line of three-wheel road rollers. This comprises a group of variable weight rollers of the three-wheeled type.

One of these new models, the 7 to 8-ton size, is illustrated herewith. Its weight with empty rolls is approximately 14,000 pounds and with the rolls filled with water slightly over 16,000 pounds. In addition, the two large tanks mounted on the side of the roller frame will carry an additional 100 gallons, increasing the total weight still further by 800 pounds.

Other than the special water ballasted from and rear rolls, there are no changes in the basic design of Hercules rollers.

A variable weight three-wheel roller lends itself to a wider range of application without materially increasing the investment. Further details may be obtained from this publication, any Hercules Distributor, or from The Hercules Company at Marion, Ohio.



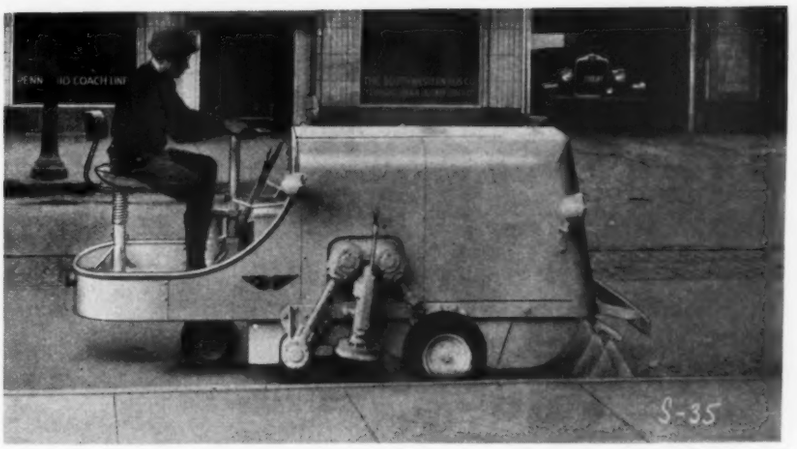
Hercules Variable Weight Roller

For Well-Drilling Work

The Star No. 75 Spudrill, a new machine announced by the Star Drilling Machine Co. of Akron, O., can be used for water well drilling, and this company is also bringing out a companion machine, the No. 73, built along the same lines as the 75, especially for water well work. The No. 75 can drill down to 3,500 feet. The machine is mounted on pneumatic tires for quick movement, and folds down so that it can be moved over any roads; it is so designed that it can be set up or taken down quickly.

"Regulatable" Oil Burner

A kerosene burner, which actually regulates the flame without forming carbon, for heating any make of tar and asphalt melting kettle has been placed on the market by the Hauck Manufacturing Company, Brooklyn, New York. This new burner, called the "High-Low Regulatable" oil burner, produces either a high flame for melting—or a low flame for holding heat. This range is obtained by moving a single control lever, which instantaneously changes the size of the flame and quantity of heat. It keeps the fuel vaporized so that the burner cannot form carbon or burn with a yellowish flame, and has a self-cleaning jet; therefore outlasts two or three ordinary torch burners. Uses only one-third the amount of oil when operating at low flame.



The Byers "White Wing Sweeper" at work

New Compact Size Street Sweeper

This sweeper, "Byers White Wing," sweeps slightly more than a four foot width of street next to curbing at an average operating cost of four cents per curb mile plus operator's wages. It uses less than 5 gals. of gas, a cupful of oil and 3 ounces of grease to sweep 20 curb-miles per day at a sweeping speed of 4.8 miles per hour.

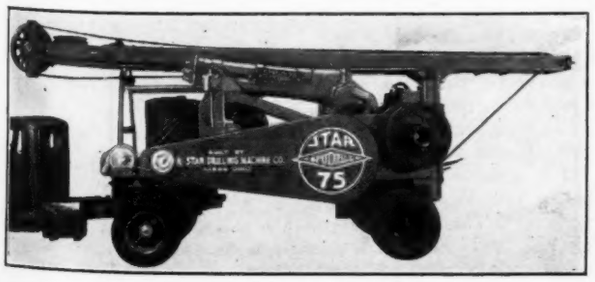
Because of its low purchase, operating and maintenance costs, it brings power sweeping methods within reach of small municipalities. Because of its smaller overall size, it is adaptable to cleaning one way streets without blocking traffic and for sweeping busy downtown areas in larger cities.

The wire gutter broom scours hard packed dirt out of the gutter, throwing it in the path of the main broom. The main pick-up broom throws litter forward, directly into the half cubic yard hopper without use of conveyor belts or drag elevators.

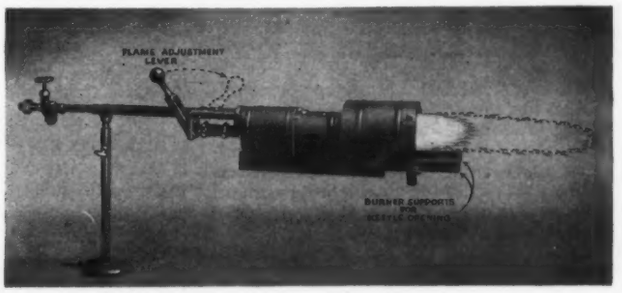
Control of brush speeds is independent of travel speeds to provide maximum flexibility for picking up every kind of litter.

The sweeper is equipped with battery, electric starter, head lights, gutter spot and tail lights for night operation plus other usual accessories. From a 60-gal. tank, a fine spray of water is laid in front of the machine to dampen dust.

Complete catalog description of the Byers "White Wing" may be procured by writing direct to The Byers Machine Co., Ravenna, O., or to PUBLIC WORKS Magazine, 310 E. 45th St., New York City.



The New Star No. 75 Spudrill

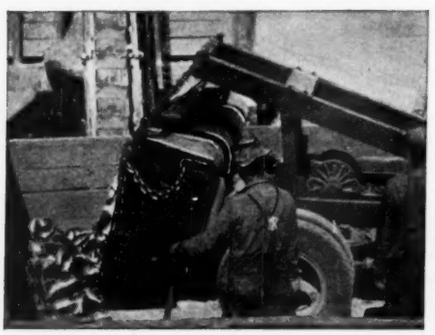


How the Hauck regulatable oil burner works

The Brooks
LOAD LUGGER
PATENTED & PATENTS PENDING

Never before, have we produced, or seen, a piece of equipment that so quickly convinces, even the most skeptical prospect, of its immediate value. The Brooks Load-Lugger is the most practical, fool-proof and greatest cost-cutting method known for hauling and dumping

any type of material where loading must be done by hand. When one truck with Load-Lugger and several Load-Lugger Buckets can replace several trucks, costs drop fast. Shipped assembled, the Brooks Load-Lugger is ready for installation on any truck chassis within a few hours. It is operated by a Rotary Hydraulic Hoist, no high-pressure hydraulic hose, no cables, sheaves or "gadgets" for "stop-and-fix-it" troubles. Built in four capacities, buckets of one piece construction, ONE MAN op-



erated from driver's seat, dumps automatically. Buckets rest directly on chassis, no suspended load, and no counter weight required. Investigate the Brooks Load-Lugger at once, its performance will surprise you. Write for complete details and prices. Demonstration arranged in most sections for interested parties.

BROOKS EQUIPMENT & MFG., CO.
39 DAVENPORT ROAD, KNOXVILLE, TENN.

PERSONAL ITEMS

J. L. Barron has resigned as director of the Division of Sanitation of the Westchester County, N. Y., Department of Health. He has been appointed county sanitary engineer of Nassau County, N. Y., and will organize a division of sanitation there. Mr. Barron has been with Westchester County since 1930, in charge of water, sewage, food and milk sanitation, swimming pools and camps. No successor has, as yet, been appointed we understand.

Edward C. La Valley of New Rochelle, N. Y., has been appointed to the engineering staff of the Westchester County, N. Y., Department of Health.

C. W. Baldwin, 230 Congress St., Boston, Mass., has been appointed exclusive representative in New England for Simplex Valve & Meter Co., Philadelphia; and J. J. Henrickson, 3689 Jefferson St., Kansas City, Mo., exclusive representative for that territory.

Virginia Section, AWWA

The tenth annual conference will be held at the Hotel Robert E. Lee, Lexington, Va., Thursday and Friday, Aug. 25 and 26. H. W. Snidow, State Dept. of Health, Richmond, Va., is secretary.

Books:

Chemical Publishing Co., 148 Lafayette St., N. Y., has issued a 150-page catalog (No. 6) which lists, with price, the books of nearly all publishers, both American and English, covering engineering, chemistry, bacteriology, medical and general scientific. Saves you from looking through a lot of book catalogs. Spiral bound. Catalog is 10 cents.

Cutting Torches:

A new cutting-torch bulletin, more extensive and informative than the usual publication, has been issued by Victor Equipment Co., San Francisco, Calif. Discusses the "fuel" gases, torch cutting speed and many other phases of the work, and gives some excellent instructions with each step illustrated by a specially posed photo. Sent on request.

Plumbing Details:

For the architect or sanitary engineer whose work includes the design of plumbing details, knowledge of space requirements, systems of plumbing and methods of connecting equipment, this book will be more than a handy time-saver. Excepting for certain diagrams, all drawings are to scale; plates are drawn to meet the codes more generally in use, and can be adapted to meet local requirements with minor changes. There are 119 plates; the book is 9¼ by 11½ ins. It sells for $6. John Wiley & Sons, Inc., New York. The author is Louis J. Day.

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Readers' Service Department

These booklets are FREE to readers of PUBLIC WORKS.

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Feeders, Chlorine and Chemical

387. For chlorinating small water supplies, swimming pools and other installations. Flow of water controls dosage of chlorine (or other chemicals) providing required dosages, which are immediately adjustable. Driving is started and stopped automatically. Send for newest literature. %Proportioneers%, 9 Codding St., Providence, R. I.

Filter Plant Controllers

388. "The Modern Filter Plant" and the uses of Simplex Controllers for operation are described in a handy, 16-page booklet. Charts, data, curves and tables. Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Flow Meters

389. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Gate Valves and Hydrants

390. An 84-page catalog gives full design data, information about and illustrations of the complete line of Darling Gate Valves and Hydrants. Write for one to Darling Valve and Mfg. Co., Williamsport, Pa.

391. Two new bulletins on M-H fire hydrants and fully bronze mounted gate valves are now ready. Contain full specifications and instructions for ordering, installing, repairing, lengthening and using. Write M. & H. Valve & Fitting Co., Anniston, Ala.

392. 28 page catalog contains illustrations and complete specifications of M-H standard and extra heavy iron body gate valves, horizontal swing check valves, flanged fittings and flanges, etc. Sent promptly on request by M. & H. Valve & Fittings Co., Anniston, Ala.

Indicators, Rate of Flow

400. This rate of flow indicator is a new, simple, compact, ruggedly constructed instrument which indicates flow with great accuracy in filtration and softening. Described and illustrated in new bulletin issued by The Permutit Company, 330 West 42nd St., New York, N. Y.

Manhole Covers and Inlets

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron

406. Data on cast iron pipe for water works systems, in sizes from 1¼ to 84 inches, including information on useful life, flow data, dimensions, etc., Thos. F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Pipe, 2-inch Cast Iron

407. The new McWane 2" cast iron pipe in 18-foot lengths has innumerable uses in water and sewage work. Send for the new McWane bulletin describing this pipe, the various joints used, and other details about it. McWane Cast Iron Pipe Co., Birmingham, Ala.

Pipe, Large Cast Iron

408. Handy cast iron pipe and fittings catalog contains A.W.W.A. and A.G.I. standard specifications for a wide variety of cast iron pipe specialties, both bell and spigot and flanged; also dimensions Lynchburg Foundry Co., Lynchburg, Va.

409. Information on concrete pipe for sanitary or storm sewers which can be made anywhere by manufacturer using local labor and materials. Write Concrete Pipe Machinery Co., Sioux City, Iowa.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints, Sewer

415. How to make a perfect sewer pipe joint—tight, prevents roots entering sewer, keeps lengths perfectly aligned; can be laid with water in trench or pipe. General instructions issued by L. A. Weston, Adams, Mass.

416. Stop Root rings are used with clay or concrete pipe, without special tools, to make perfect joints that prevent roots entering sewer. Joints are made in usual way. A-B-C Mfg. Co., 227 So. 4th St., Quincy, Ill.

Taste and Odor Control

417. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

Pumps and Well Water Systems

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Pumping Engines

424. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Root-Proofing

425. Free sample of "Stop Root Ring" for root-proofing clay or concrete pipe without tools, and complete descriptive matter will be sent on request to A-B-C Mfg. Co., 227 So. 4th St., Quincy, Ill.

Run-off and Stream-Flow

426. Excellent booklet describes and illustrates the latest types of instruments for measuring run-off, both from small areas for storm sewer design, and from large areas for determining water shed yield. Sent promptly by Julien P. Friez & Sons, Baltimore, Md.

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428. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straight-line Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago, Ill.

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430. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co., Wabash, Ind.

Rainfall Measurement

432. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Bulletin RG and Instruction Booklet. Julien P. Friez & Sons, Baltimore, Md.

Screens

435. Water Screen Book No. 1252, describes traveling water intake screens and gives complete technical information about them. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Sewage Filters, Magnetite

436. Well illustrated booklet describes the magnetite filter, and tells how it is used in the treatment of Sewage. Copy on request from Filtration Equipment Corp., 10 East 40th St., New York, N. Y.

Small Septic Tanks

438. Septic Disposal Systems, Waterless Toilets, Multiple Toilets for Camps and Resorts, and other products for providing safer sewage disposal for unsewered areas are described and illustrated in data sheets issued by San-Equip, Inc., 700 Brighton Ave., Syracuse, N. Y.

Sludge Incineration

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection, 45 pp., Ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202P East 44th St., N. Y.

Swimming Pool Equipment

444. A new booklet "Essential Factors in the Design and Layout of Swimming Pool Systems," with data on filtration equipment, fittings, solution feeders, accessories, etc., is available from Everson Manufacturing Co., 213 West Huron St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

446. 40-page Manual on swimming pools. Includes swimming pool layouts, specifications, etc., and details concerning Permutit Swimming Pool Equipment. Write The Permutit Co., Dept. G-4, 330 West 42 St., New York, N. Y.

Treatment

450. Standard Sewage Siphons for small disposal plants and PFT Rotary Distributors are new catalogs recently issued by Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill. The latter catalog contains typical plans and many illustrations of actual installations.

453. New booklet on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures and drawings of installations, sanitary engineering data and design details. Link-Belt Company, 307 North Michigan Ave., Chicago, Ill.

454. Full information regarding their newest equipment for sewage treatment and water purification will be sent on request by The Dorr Co., 570 Lexington Ave., New York, N. Y.

Water & Sewage Treatment Chemicals

500. Aluminum sulphate and ferric chloride for sewage coagulation, and these chemicals and ammonia, copper sulphate and others for water treatment. Information on uses and methods sent on request to General Chemical Co., 40 Rector St., New York, N. Y.

501. "Ferrisul for water and sewage treatment." What it is; what it will do for you and how to use it—a handy booklet issued by Merrimac Chemical Co., Everett Station, Boston, Mass.

Valve Box Tops

475. "Cut the Cost, but Not the Pavement," is the theme of a new bulletin on Rite-Hite Valve Box Tops. Gives directions for forming new tops on valve boxes, quickly and inexpensively without digging up the old box. Just issued by Trohn's Supplies, Inc., 205 Hoyt Ave., Mamaroneck, N. Y.

Water Works Operating Practices

490. "What Is New In Coagulation" is an excellent, new review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., Curtis Bay, Baltimore, Md.

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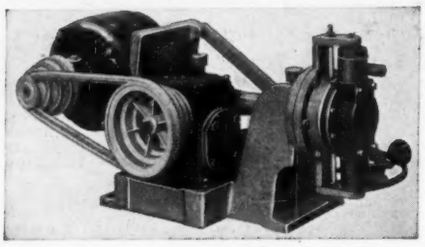
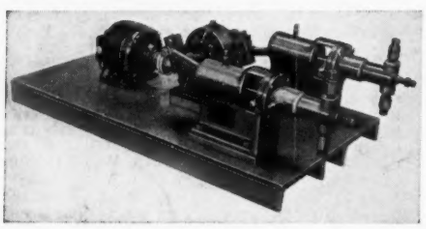
No matter what process, if YOU are feeding ONE chemical,



feeding TWO chemicals,



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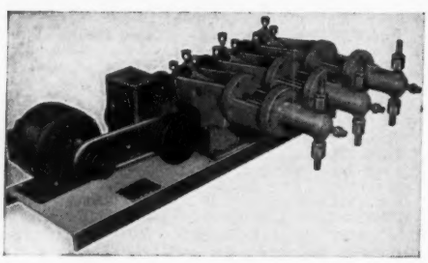
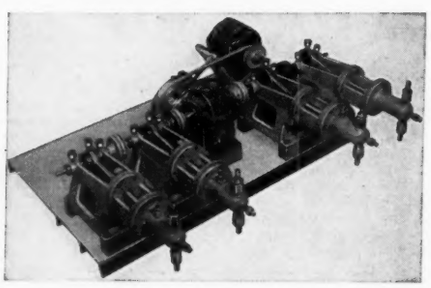


or feeding FOUR or more



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For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Mosquitoes:

"Mosquitoes, Their Life History and Control" is an excellent and interesting booklet of 32 pages. It tells most of what the average man needs to know about mosquitoes, how they grow, how to identify them and what to do about them. There are some excellent pictures, too—but we think that most of our readers will also profit very materially by that section which describes "telling our story with displays." How to do that is something that many of our city, county and state folks need to know a lot more about. The booklet will be sent on request to Nassau County Extermination Commission, 411 South Grove St., Freeport, N. Y. We suspect this excellent publication is the work, principally, of two of the able young men of the Commission—Messrs. Longworth and Skidmore. Congratulations to them.

Sewer Pipe Book:

Complete information on Transite sewer pipe is contained in this 16-page, well-arranged booklet. Installation advantages, low maintenance costs, prevention of infiltration and resistance to breakage and other damage are treated. Specifications for the pipe, a table of crushing strengths and dimensions and weight tables are given. Ask for Book TR-21A, Johns-Manville, 22 East 40th St., New York.

Construction Data:

Designed to help highway engineers and contractors, this is one of those useful pocket booklets quite uniformly issued by manufacturers of tars, asphalts or other road materials. In its some fifty pages are many tables, some not usually found elsewhere, that should help the field man; also specifications and directions for building many types of bituminous surfaces. The Barber Asphalt Co., Philadelphia, Pa.

Street Sweeping:

The new Austin-Western "Patrol Sweeper" is described and illustrated and information on its use for cleaning streets is given in a 8-page booklet just issued by Austin-Western Road Machinery Co., Aurora, Ill. This new small sweeper has greatly reduced the cost of cleaning and brings this needed equipment to a wider range of cities.

Tire Handbook:

Valuable aid to all users of rubber tired tractors and implements is a new handbook of service information just made available by The Goodyear Tire & Rubber Company, Akron, Ohio. Contained in the booklet is information on various means of inflating tires; how to put water in tires for weighting purposes; how to prevent the water from freezing with calcium chloride and other anti-freeze agents; hints on protection and care of tires; also are specific tables of loads and recommended inflations for all sizes of tires and for determining the amount of water various size tires may use to best advantage in terms of both gallons and pounds. Twenty-four detailed photographs illustrate every step in the mounting and demounting of tractor tires, showing clearly how to use tire tools and simplify all incidental operations in the process. Ask for Booklet S-1124. The Goodyear Tire & Rubber Company, Akron, Ohio.

Sodium Chloride Stabilization:

International Salt Co., Inc., Ithaca, N. Y., has issued an 18-page booklet, "Developments in Road Stabilization With Sodium Chloride," which describes the methods of use of salt with gravel or limestone screenings for consolidating road surfaces. Sent on request.

Tank Car Heaters:

An excellent and instructive booklet on tank car heaters, pumping boosters, storage tank boosters, automatic heaters for asphalt plants and tank car unloading valves. Gives you about what you ought to know on handling bituminous materials from tank cars and storage tanks. Sent on request to Cleaver-Brooks Co., Milwaukee, Wisc.

Explosives:

A new 36-page pamphlet entitled *Explosives for Field Clearing*, and now available for distribution, will be helpful to those who face the problem of getting rid of stumps and boulders. The proper methods for placing explosives charges for different types of stumps and boulders are described and illustrated with diagrams. Copies of the pamphlet may be obtained from the Agricultural Extension Division of the du Pont Company, Wilmington, Delaware.

Enginering Terminology:

This book is about as interesting as a dictionary to read—and about as handy when you need one. We all know that many words used in ordinary conversation or writing have different meanings when used in the technical sense. This is important in writing contracts. There are some 300 pages of just the kind of information you need once in a while, but awful bad then. Written by Victor J. Brown and Delmar G. Runner. The terms have been checked and approved by a committee of the technical society or trade association of that particular branch of engineering. A fine job! Gillette Publishing Co., Chicago, Ill. $3.50. plus postage.